- DATA COMMUNICATION (HARDWARE)
- POWER SUPPLY
- OPERATOR'S COMMUNICATION
- SAFE BUS AND WATCHDOG
- BLOOD PUMPS AND CLAMPS
- ARTERIAL AND VENOUS PRESSURE
- AIR DETECTOR
- PRIMING DETECTOR
- DEGASSING PUMP
- FLOW OUTPUT PUMP
- FLOW INPUT PUMP
- TEMPERATURE
- CONDUCTIVITY
- TMP AND UF SYSTEM
- DIRECT VALVE
- DEGASSING LEVEL REGULATION
- DEAIRATING LEVEL REGULATION
- BLOOD LEAKAGE DETECTION
- CONCENTRATE TUBE SENSORS
- PII-UNIT

BASIC STRUCTURE

The AK 100 contains totally seven (7) micro-processors. Two (2) of these are used as watchdogs, one (1) in BM and one (1) in FM.

The other are named **CPU A** through **CPU E**.

CPU A is used in the control system and **CPU B** in the protective system in **BM**.

CPU D is used in the control system and **CPU C** in the protective system in **FM**.

The flow control system has its own micro-processor, **CPU E**.

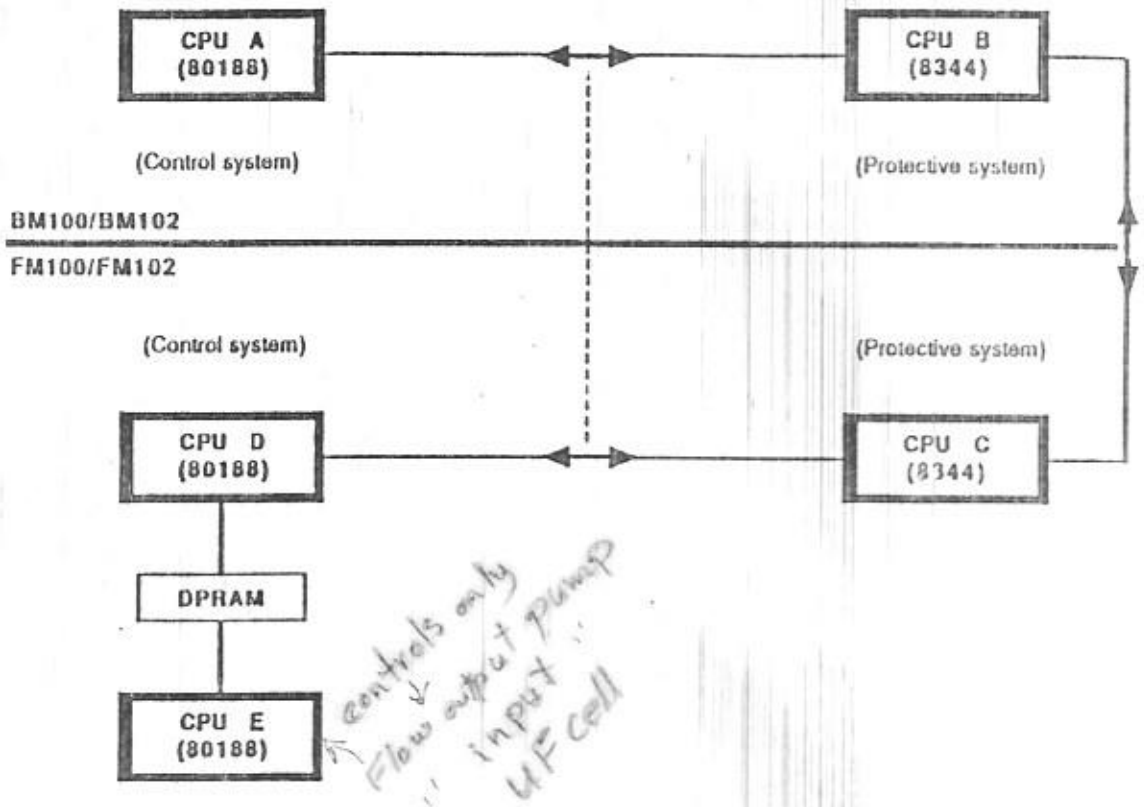


Fig.1. BASIC STRUCTURE

DATA COMMUNICATION (Hardware)

The communication between the micro-processors is done in three (3) different ways.

The communication between **BM** and **FM** is done by a bi-directional serial interface.

The internal communication between **CPU A** and **CPU B** is done by an 8 bits bi-directional parallel interface.

It's the same between **CPU C** and **CPU D**.

The communication between **CPU D** and **CPU E** use also an 8 bi-directional communication but it's done through a **Dual Port RAM (DPRAM)**. The **DPRAM** can be seen as two (2) **RAMs**, connected in parallel into one (1) chip.

CPU D and **CPU E** can read and/or write data simultaneously as long as the addresses are not the same.

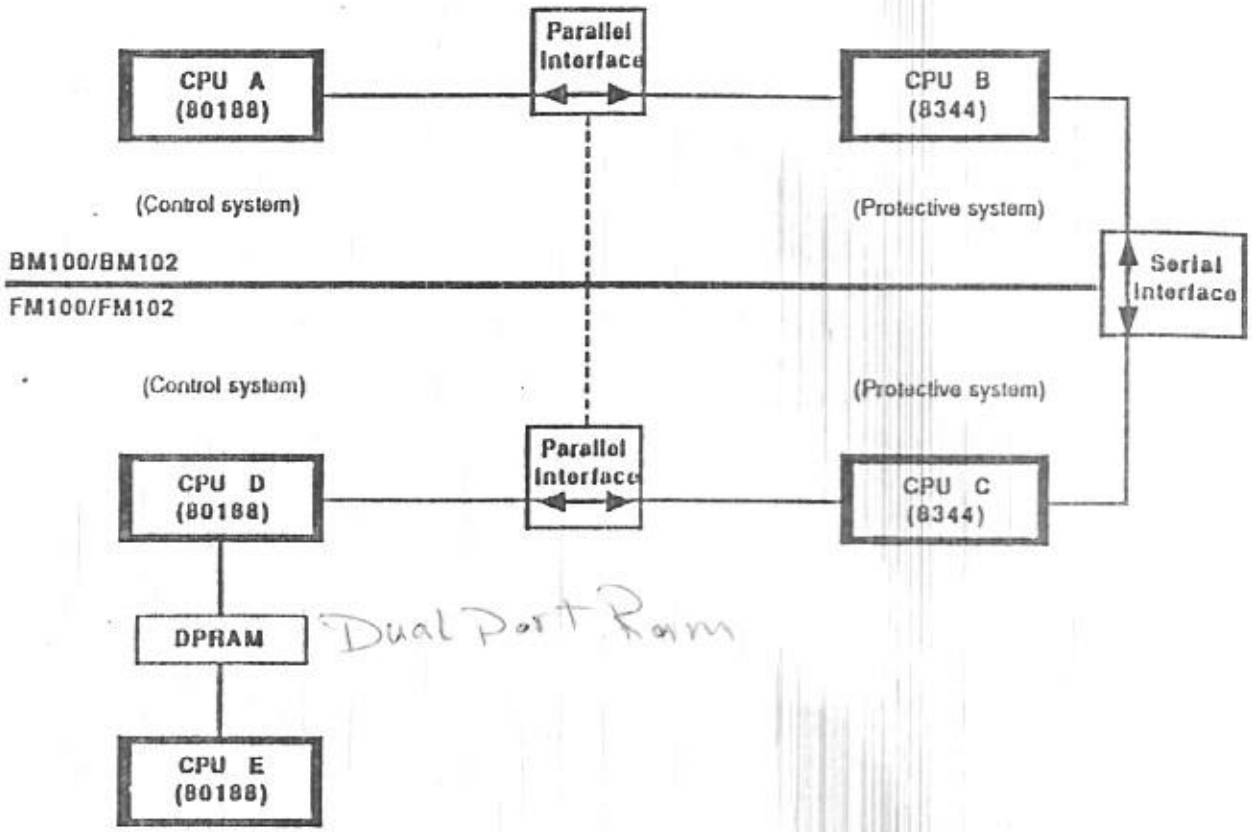


Fig.2. DATA COMMUNICATION (hardware)

DATA COMMUNICATION (Software)

CPU A is the communication master in the complete AK 100 system.
CPU B is the communication master in the protective system.
CPU C is a communication slave.
CPU D is a communication slave.
CPU E is directly connected to **CPU D** via a **Dual Port RAM** and is not connected to the data communication.
The bitbus is a communication slave.

The communication masters decide, **CPU B** will be told by **CPU A**, in which of the following communication modes AK 100 is in:

1. Functional Check
2. Treatment
3. Disinfection
4. Service
5. Preset

Depending on mode, different data blocks and requests for data blocks will be sent out ot the slaves and the slaves will "fill in" the actual information and return the requested data blocks.

The idea of having different communication modes is to avoid sending around a lot of parameters that are not in use for the moment.

Parameters for **CPU C**, which are named **QRI**, **QRL**, **QRW** a.s.o, that should be sent around in the system are converted to **PRI**, **PRL**, **PRW** a.s.o. by **CPU B**.

Note that a parameter that is produced in the **CPU C** and should be used in **CPU D** is not directly sent from **CPU C** to **CPU D**, instead the following will happen:

1. **CPU C** sends QRI(x) to **CPU B**.
2. **CPU B** converts QRI(x) to PRI(y).
3. **CPU B** sends PRI(y) to **CPU A**.
4. **CPU A** sends PRI(y) directly to **CPU D** even though it passes through **CPU B** and **CPU C**.

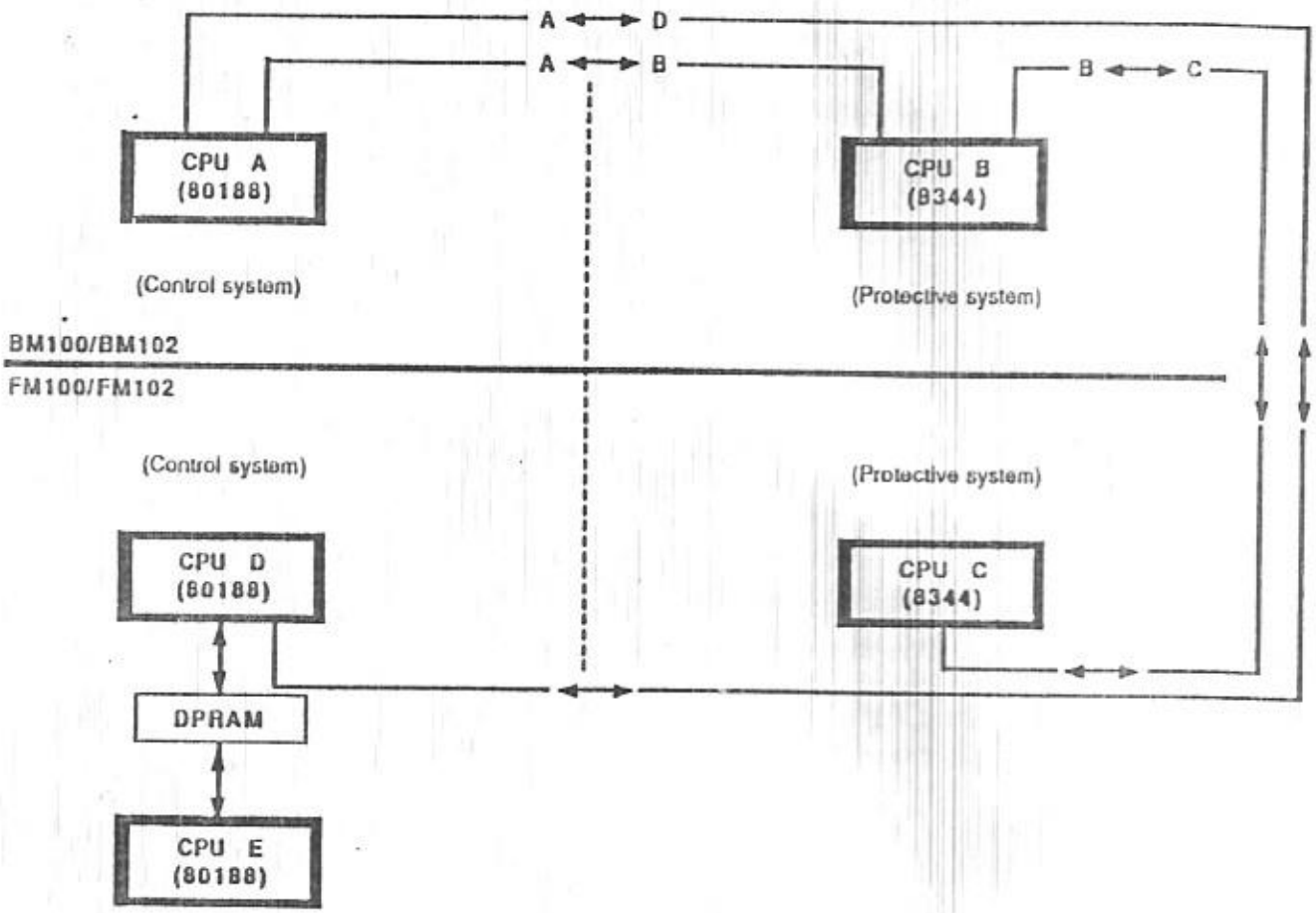


Fig.3. DATA COMMUNICATION (software)

POWER SUPPLY

The electronics needs **+24V, ±12** and **+5V.** +5V is used for the logic circuits, ±12V for the analog circuits and +24V for all lamps on the instrument panel, the displays, the blood pump(s), the heparin pump, the fan and the electromagnetic clamps in the BM and for the pump motors, the valves, the heater relays and the fan in the FM.

+24V comes out from the AC/DC-unit. This voltage goes also to one (1) DC/DC-unit in the BM and one (1) in the FM-unit.

Each DC/DC-unit produces stabilized ±12V and +5V.

At POWER ON, each DC/DC-unit outputs a **PORE**/-signal for RESET of all micro-processors.

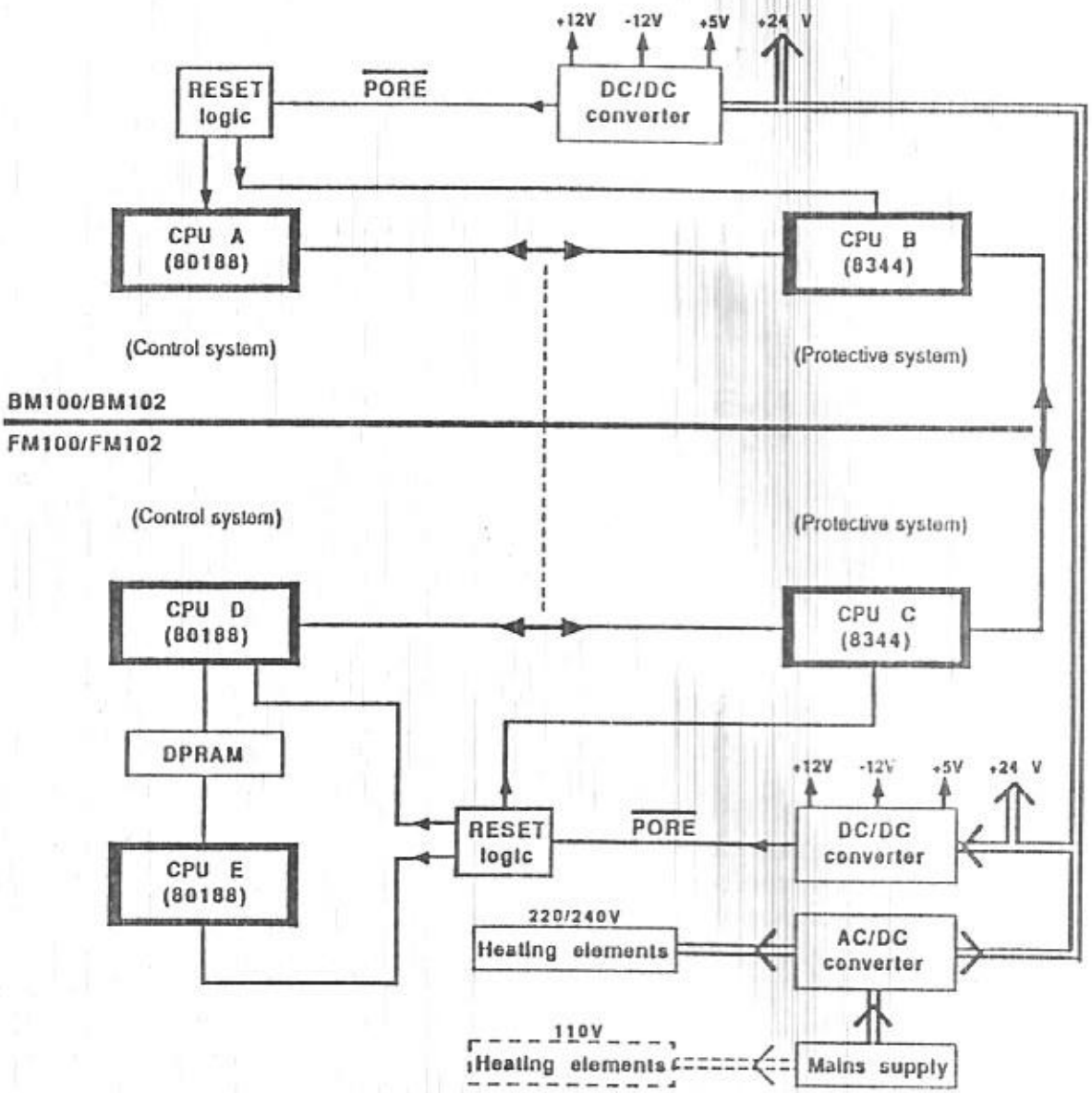


Fig.4. POWER SUPPLY

OPERATOR'S COMMUNICATION

The instrument panel communication is divided between **CPU A** and **CPU B**.

The keyboard is scanned by a "Keyboard Controller" - IC and after decoding the information is fed into **CPU A**.

Depending on which key has been depressed, a lamp will lit up and a certain bargraph display value can be SET or changed as well as the alarm limits.

The blood flow rate is set by a separate knob which has immediate access to the blood pump speed control via **CPU A.**

CPU A uses a database for storing and comparing with maximum and minimum limit.

CPU B takes care of the information display. The information display is displaying a lot of text and values depending on what's happening in the machine. The same display is used for internal **Logging** values, **Diagnostics** and information to the operator in case of incorrect handling.

CPU B as well as CPU A use a database for storing and comparing with maximum and minimum limit.

By using a **code word**, the operator gets access to the **"Service Mode"**, **"Presetting"** values like the chemical contents in a certain concentrate, different languages, etc.

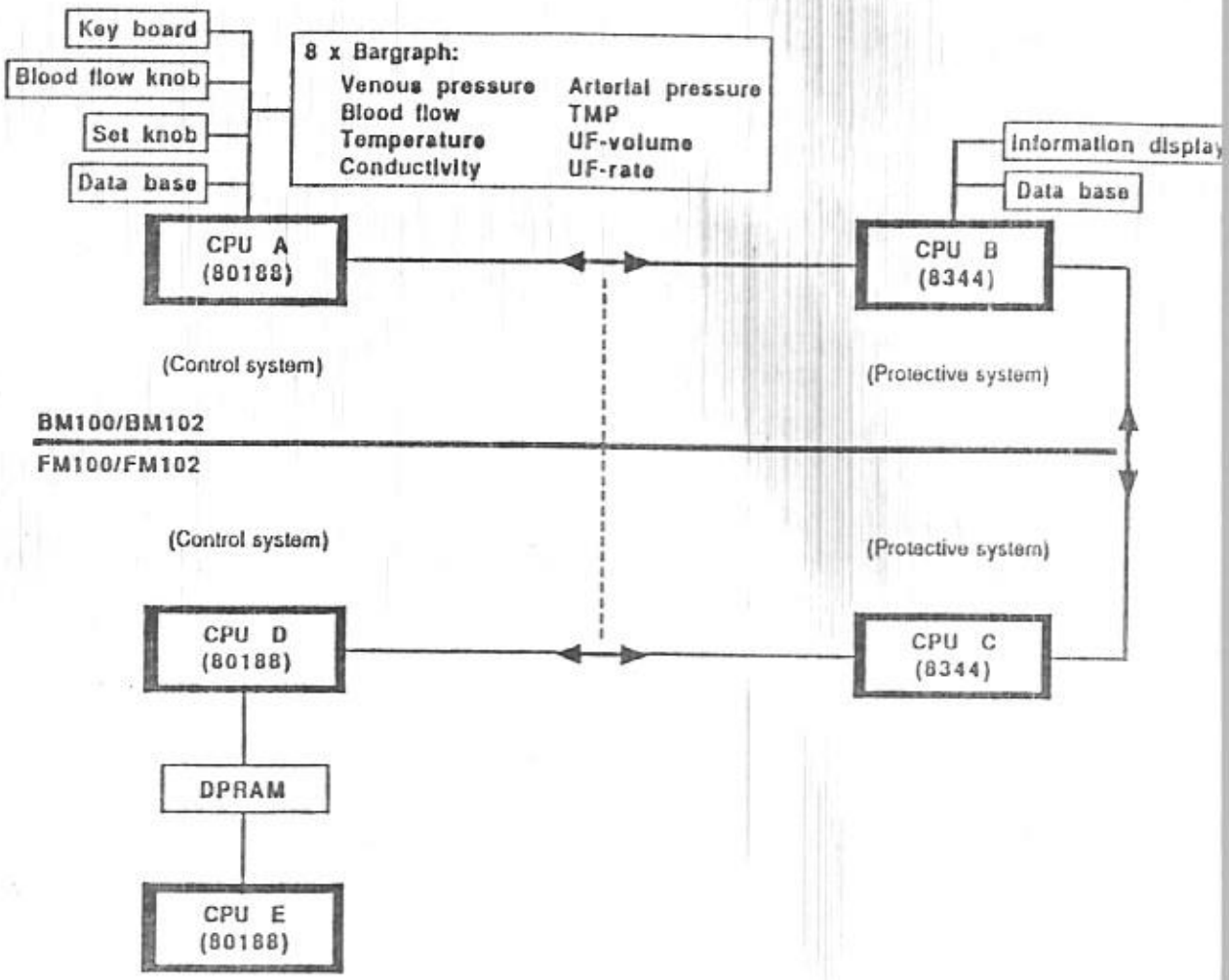


Fig.5. OPERATOR'S COMMUNICATION

SAFE BUS AND WATCHDOG

The **SAFE BUS** can be seen as an AND-gate with a lot of inputs.

These input signals must be alright in order to activate two (2) relays, one (1) in the BM for power supply to the blood pumps, and one (1) in the FM for power supply to the flow pumps and the **Inlet valve (INVA)**. This is done for the patient safety reasons. The **SAFE BUS** is supplied from a current generator and the current passes through the BM-circuits and then through the FM-circuits to ground.

The Watchdog in the BM and FM is sensing by a trigger pulse whether **CPU B** and **CPU C** are working properly. If the trigger pulse is missing, the watchdogs output RESET-signals to the CPUs. The watchdogs themselves get RESET-signals from the DC/DC-units at POWER ON.

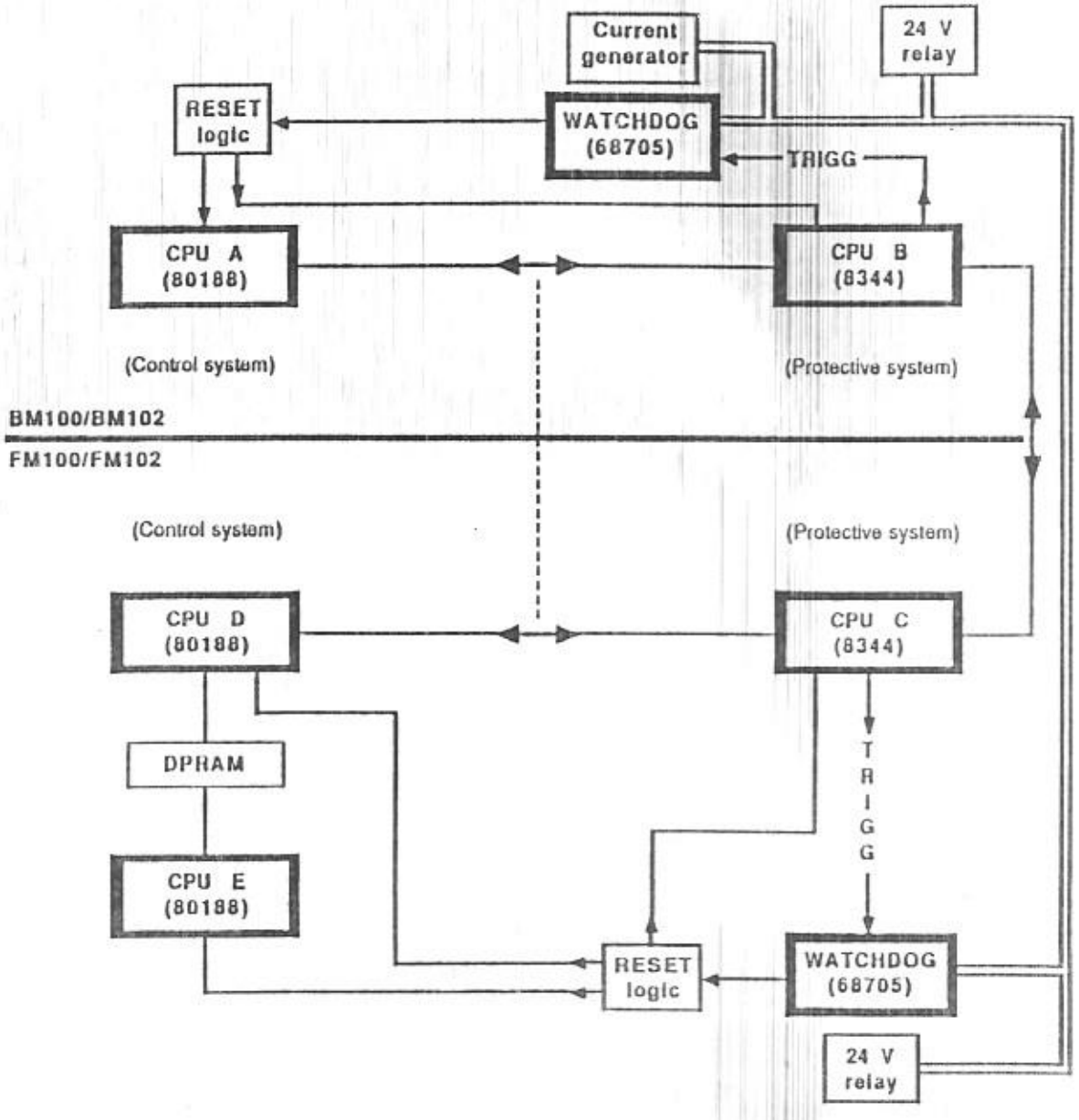


Fig.6. SAFE BUS AND WATCHDOG

BLOOD PUMPS AND CLAMPS

The blood pump(s) are controlled by CPU A by means of manually stop/start via tne blood pump button, speed, over load, pump cover open and certain alarms.

CPU B is sensing whether the pump rotor(s) are rotating or not. It's done by a opto device.

The **Arterial and Venous clamps** are mainly controlled by **CPU A** but in case of a malfunction in the machine, **CPU B** will close the clamp. **CPU A** and **CPU B** are sensing whether the clamps are mechanically closed when they should be.

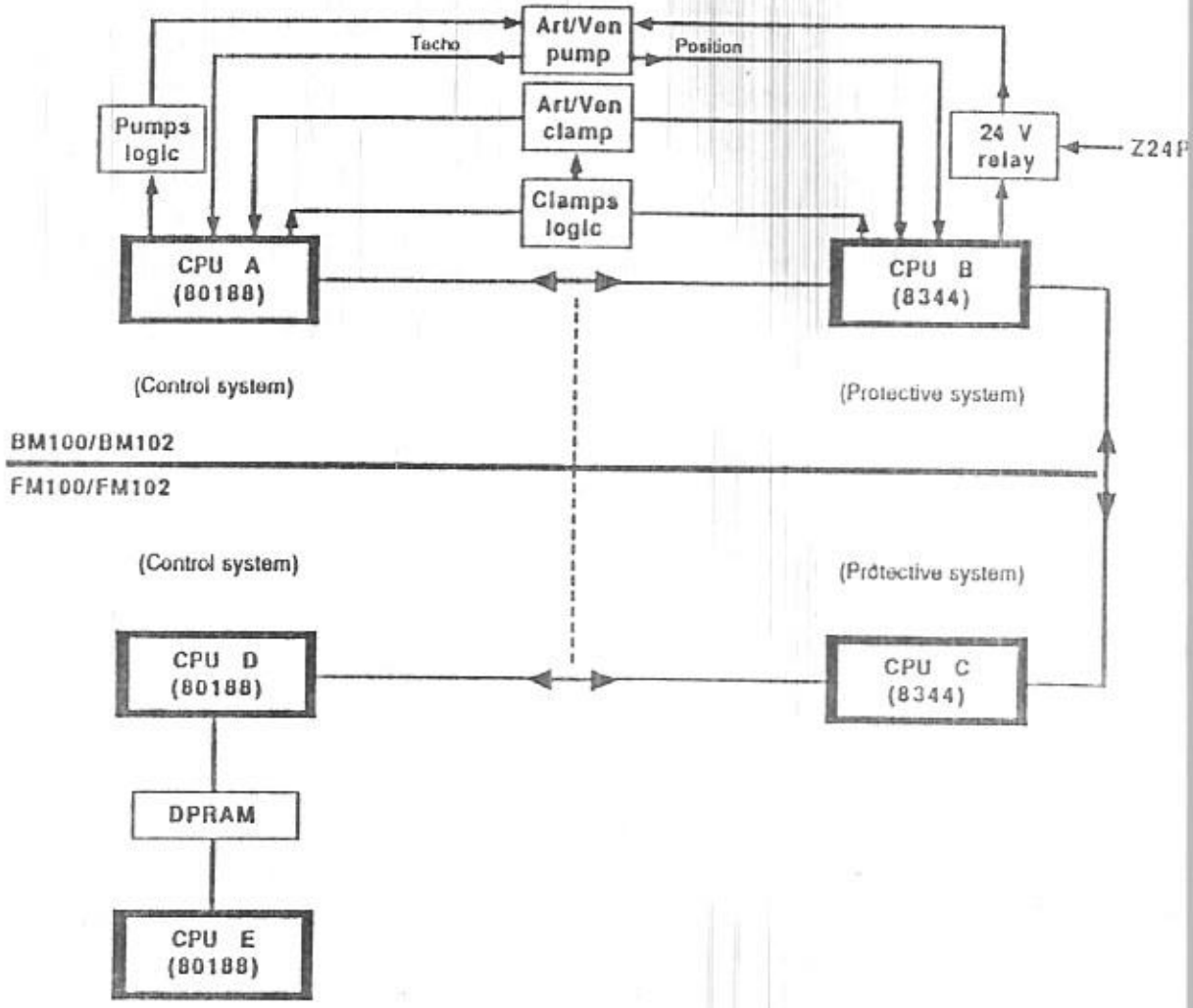


Fig.7. BLOOD PUMPS AND CLAMPS

ARTERIAL AND VENOUS PRESSURE

The mechanical pressures, applied on the arterial and/or venous pressure nipples, are converted into an electrical signal and fed to **CPU A**.

If the pressure values are outside the desired alarm limits, **CPU A** starts the alarm circuits, i.e. alarm lamp and buzzer.

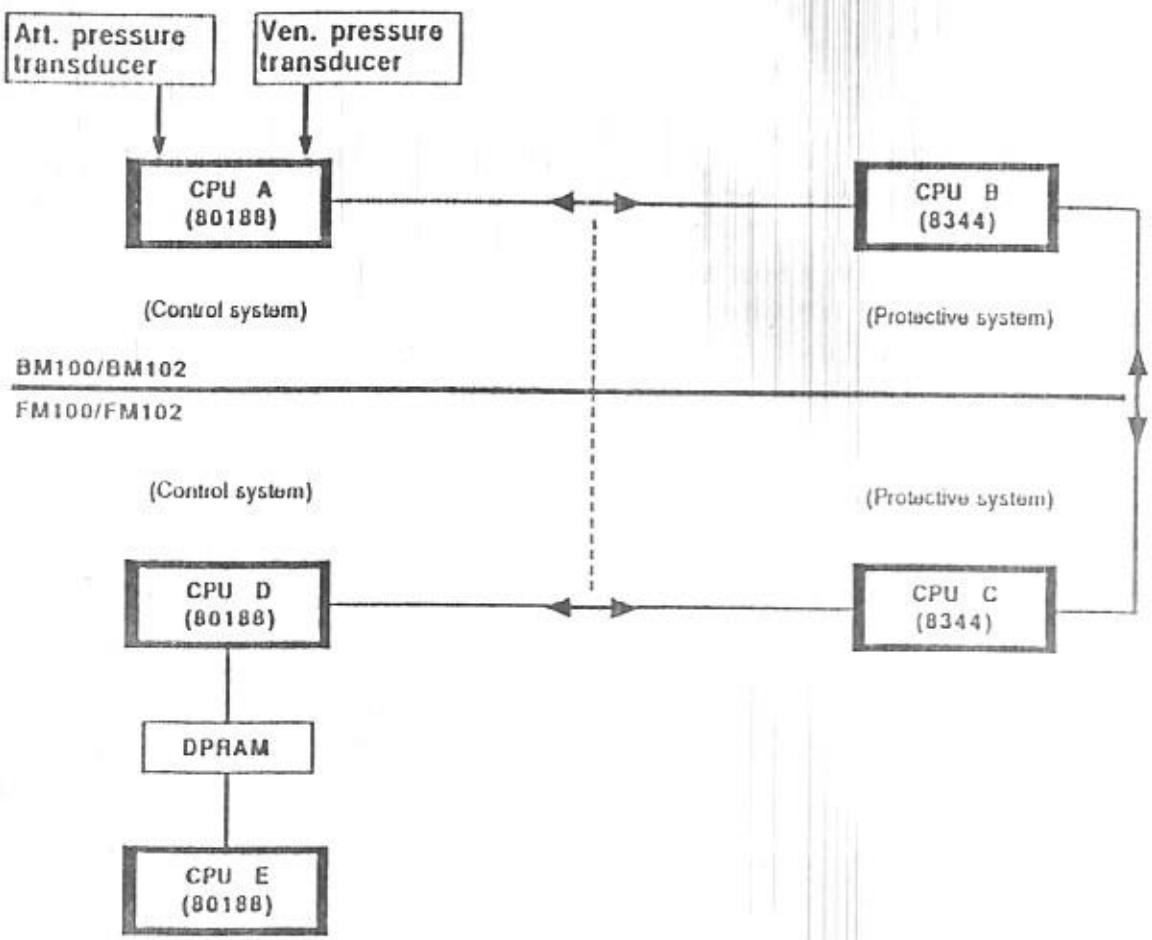


Fig.8. ARTERIAL AND VENOUS PRESSURE

AIR DETECTOR

CPU A outputs a pulse train with a high frequency to the transmitter side of the air detector head. This signal is passing through a bubble chamber in the air detector house. The pulse train consists of nine long pulses and then one short pulse.

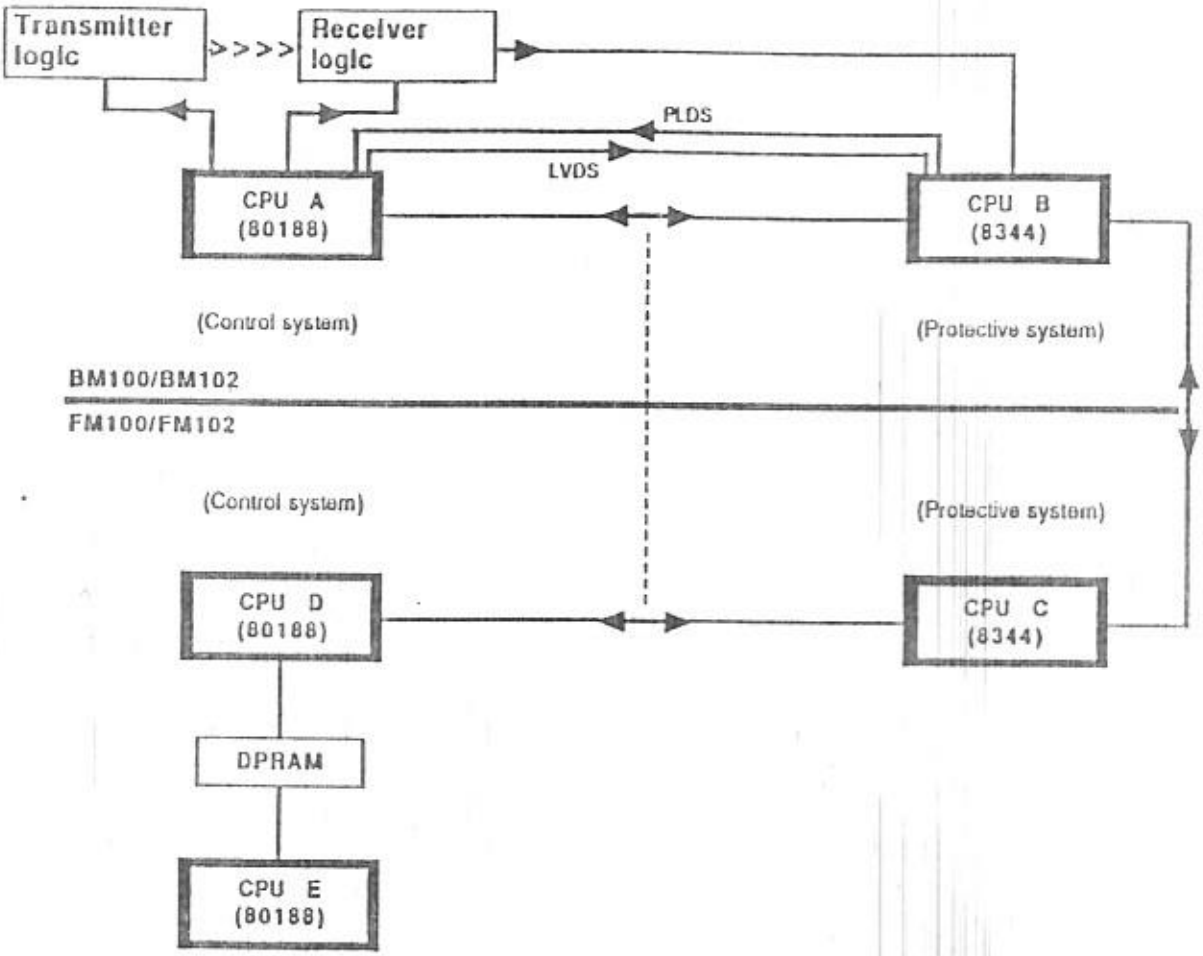


Fig.9. AIR DETECTOR

PRIMING DETECTOR

The purpose of the **PRIMING DETECTOR** is to detect if the blood level in the venous bubble chamber is high enough. **CPU A** outputs a pulse train to the transmitter side of the priming detector head. This signal is passing through the gap in the priming detector house. The signal consists of nine (9) pulses and then a pause, i.e. the pulse train is stopped. When the **CPU B** gets no pulse, it sends out a sync-pulse (**PPDS**) to **CPU B** and nine (9) new pulses are sent out from **CPU A**. As long as the priming detector detects "no blood", the signal **PPDS** is pulsing but stops as soon as blood is detected. If blood is detected for more than 20 sec., **CPU A** and **CPU B** disconnect the priming detector function and keeps it in **"blood mode"** until the **treatment time = 0.00** is confirmed. This is done by pressing the **TIME** button when the display shows 0:00.

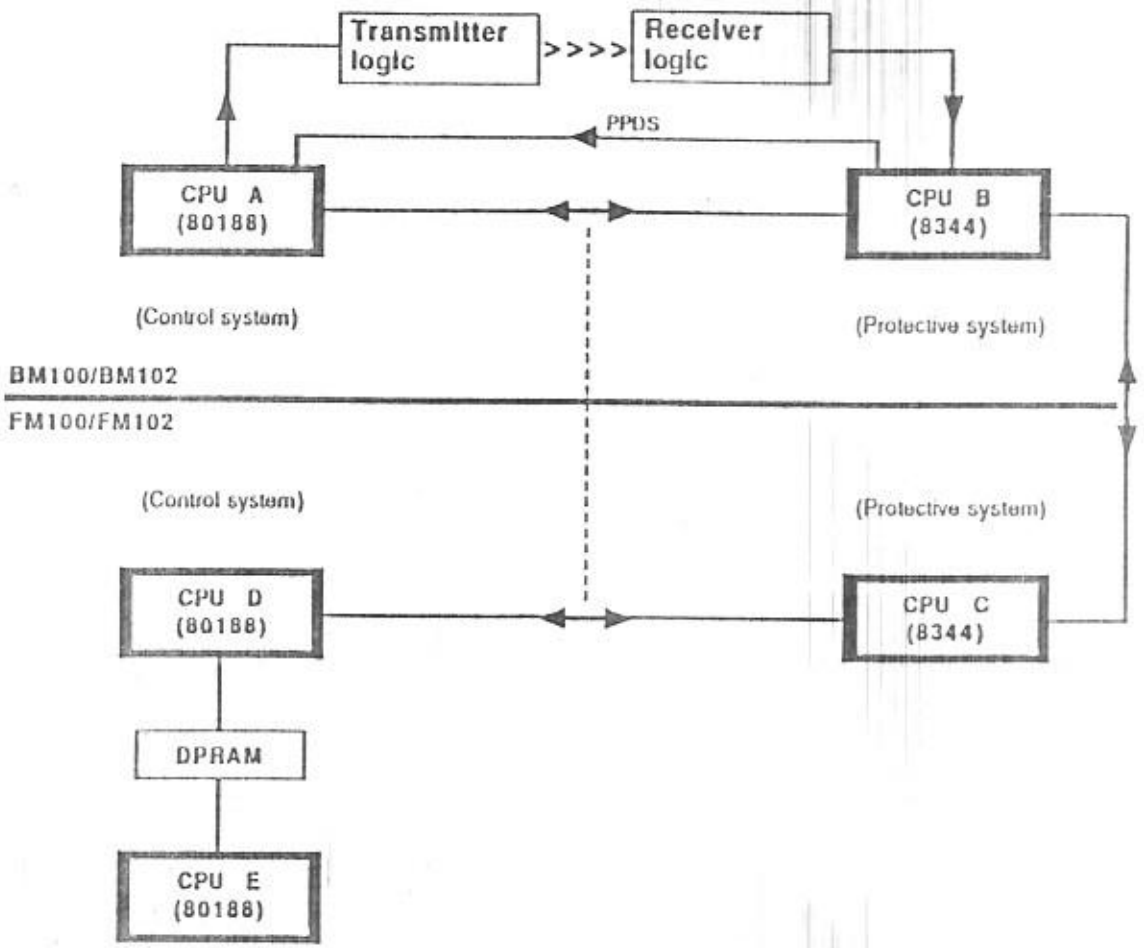


Fig.10. PRIMING DETECTOR

DEGASSING PUMP

The degassing pump is used to create a degassing pressure in the dialysate fluid.

Air bubbles appear when the degassing pump is sucking dialysate fluid through a fluid restrictor.

The degassing pressure is measured by a pressure transducer, placed on the suction side of the pump, and fed to **CPU D**.

Regulation of the pump speed comes from **CPU D**.

The motor current is measured and fed to **CPU D** to check the load of the pump.

The pump unit uses a magnet coupling to protect the motor from overload and make a fluid tight power transmission.

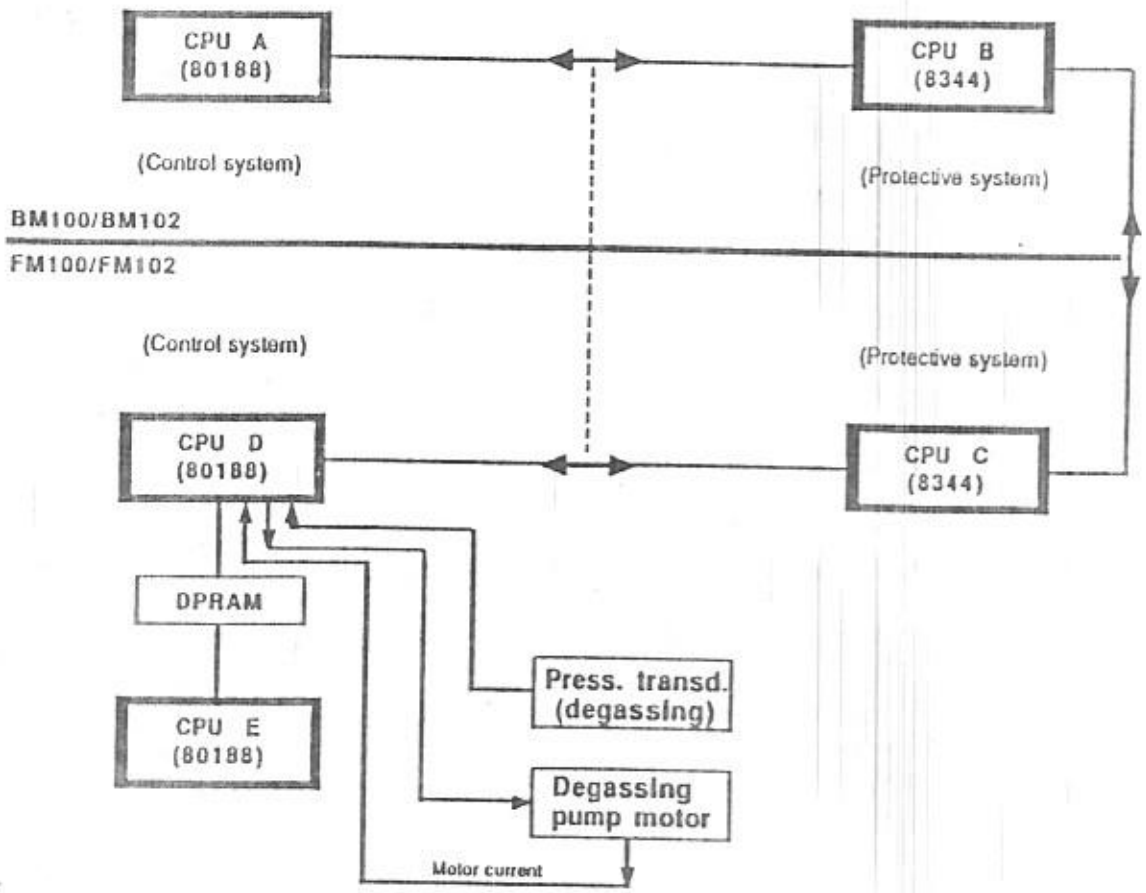


Fig.11. DEGASSING PUMP

FLOW OUTPUT PUMP

The **FLOW OUTPUT PUMP** takes carre of the main flow in the fluid system. Three (3) different flow rates can be selected 300, 500 or 700 ml/min. by exchanging two (2) restrictors forr each flow rate, one (1) placed before the **FLOW OUTPUT PUMP** and one (1) after the **FLOW INPUT PUMP**.

The pump motor speed is controlled by **CPU E**. The flow is measured by pressure drop over a restrictor by means of a pressure transducer, placed on the suction side of the pump. The motor current is measured and fed to **CPU E** to ehck the load of the pump.

The regulation of the pump speed is divided into two (2) parts. One (1) fast regulation (100/sec.) from the pressure transducer by **CPU E** and one (1) slow regulation (1/sec.) from flow channel # 1 in the UF-cell by **CPU D via the DPRAM to CPU E**.

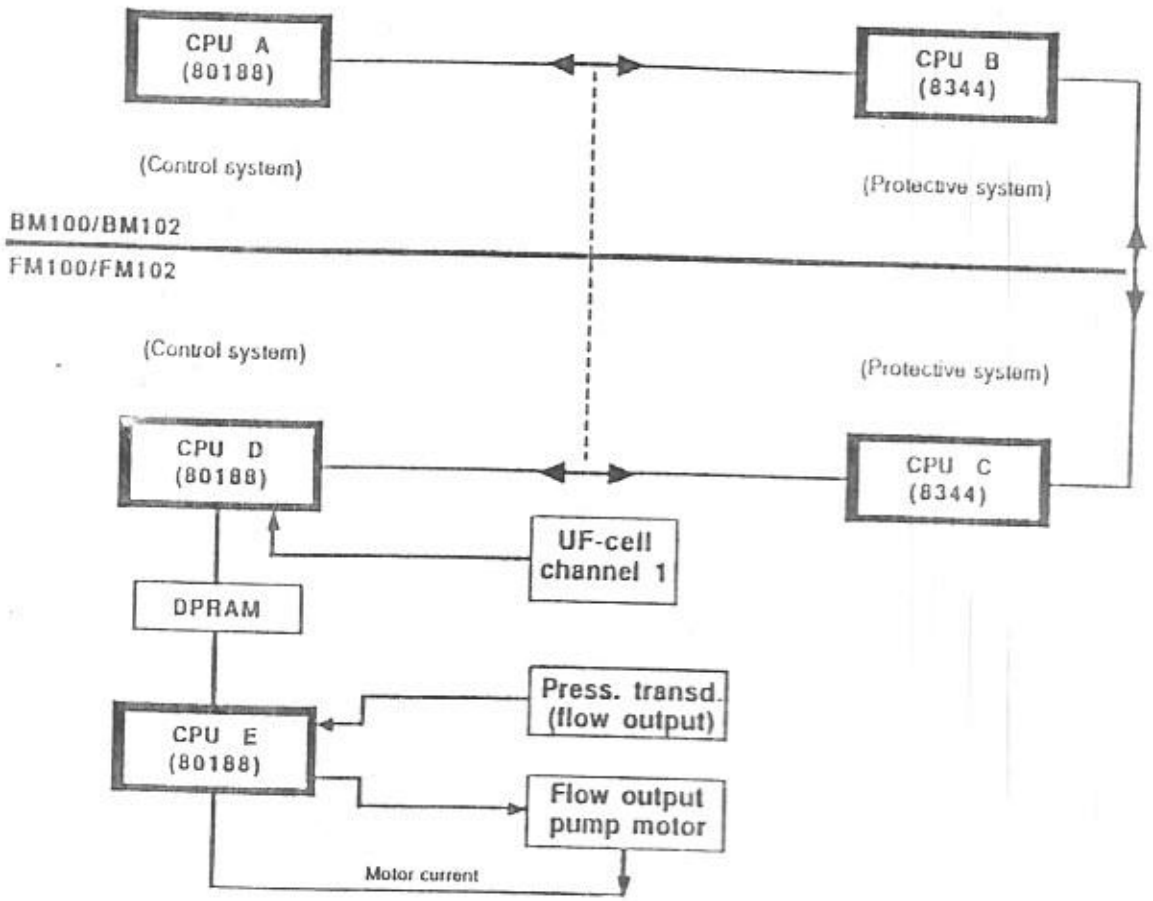


Fig.12. FLOW OUTPUT PUMP

FLOW INPUT PUMP

The **FLOW INPUT PUMP** is used to create a negative pressure in the fluid system in order to get a ultrafiltration from the patient.

The **FLOW INPUT PUMP** is either controlled by **pressure** (TMP-mode) or **volume** (volume mode).

The pump motor speed is controlled by **CPU E**. The pressure is measured by a transducer, placed on the positive pressure side of the pump. The motor current is measured and fed to **CPU E** to check the load of the pump.

The regulation of the pump speed is divided into two (2) parts. One (1) fast regulation (100/sec.) from the pressure transducer by **CPU E** and one (1) slow regulation (1/sec.) from flow channel #2 in the UF-cell by **CPU D via the DPRAM to CPU E**.

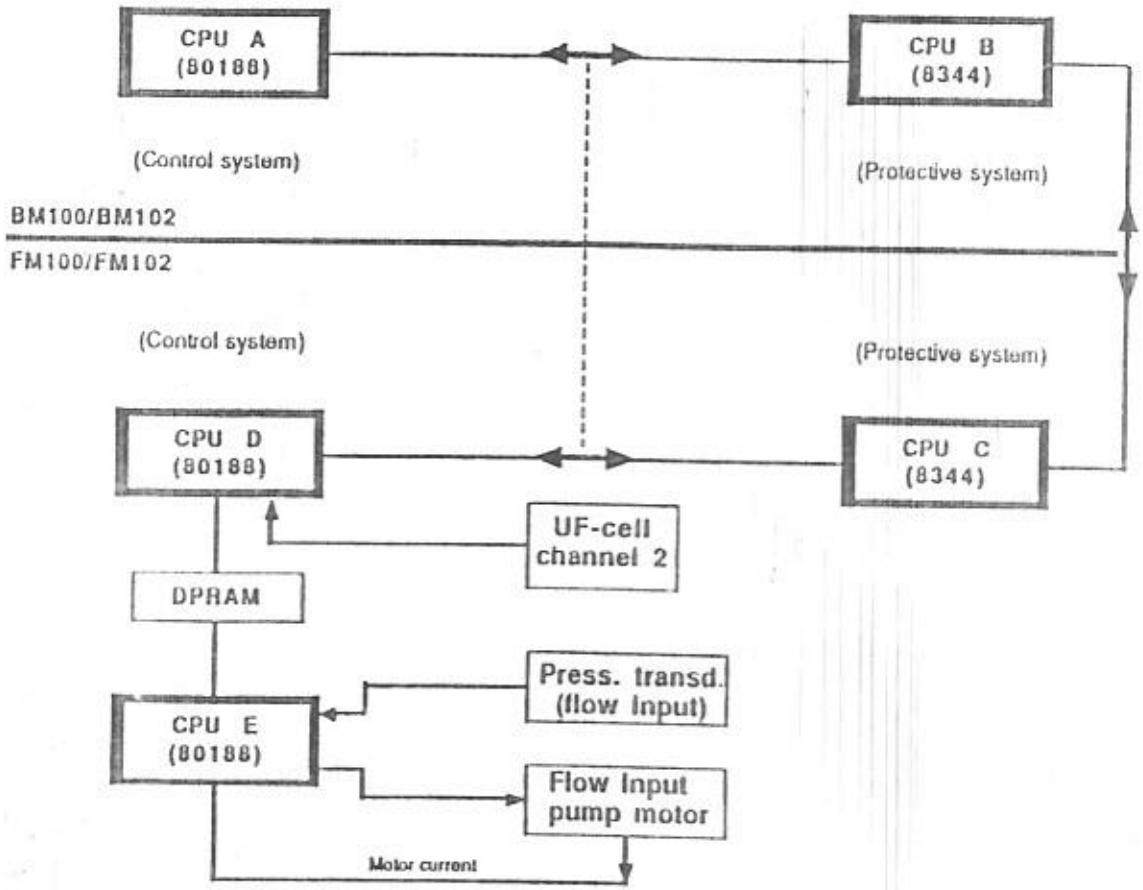


Fig.13. FLOW INPUT PUMP

TEMPERATURE

CPU D gets information about the temperature in the heating vessel for the temperature control system. By comparing the temperature set value with the temperature value in the heating vessel, it can control power ON/OFF to the heating rods.

It also gets temperature information about the **temperature in conductivity cell A**.

CPU C gets information about the **temperature in conductivity cell B**.

The temperature values from the conductivity cells are used for temperature compensation of the conductivity.

AK 100 has adjustable temperature alarm limits. In case of a malfunction in the temperature control circuits, (temperature too high, fixed limit) **CPU C** disconnects the main voltage by the safety relay.

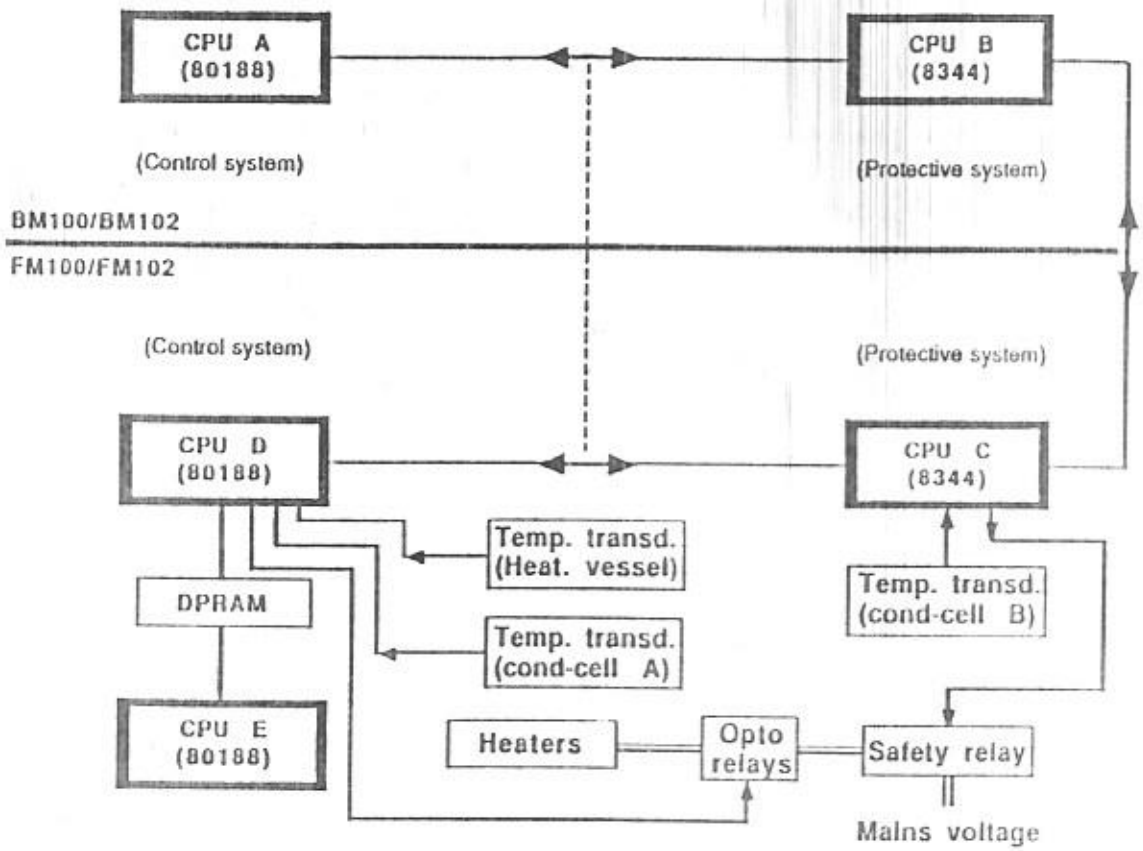


Fig.14. TEMPERATURE

CONDUCTIVITY

CPU D gets information about the conductivity values in conductivity cells A and B. These two (2) values are used in order to control the speed of **feeding pump B** in acetate mode and **feeding pumps A and pump B** in bicarbonate/BiCart mode. "A" controls the amount of **Acid Concentrate** and "B" controls the amount of **Bicarbonate/BiCart Concentrate** in order to get the expected final conductivity.

CPU C is always **monitoring the total conductivity** independently of the treatment mode and issues an alarm if the total conductivity value is outside the alarm limits, i.e. too high or too low conductivity. In such cases, the flow path goes in bypass and "disconnects" the patient.

The regulation of the conductivity is done by two (2) feeding pumps, one (1) for conductivity "A" and one (1) for conductivity "B". The pumps are controlled by CPU D. Depending on the selected mode, either **feeding pump "B"** or **feeding pump "A" and "B" are running.**

Concentrate supervision is done by means of **comparing presetted concentrate** with **stroke volume x pump RPM.**

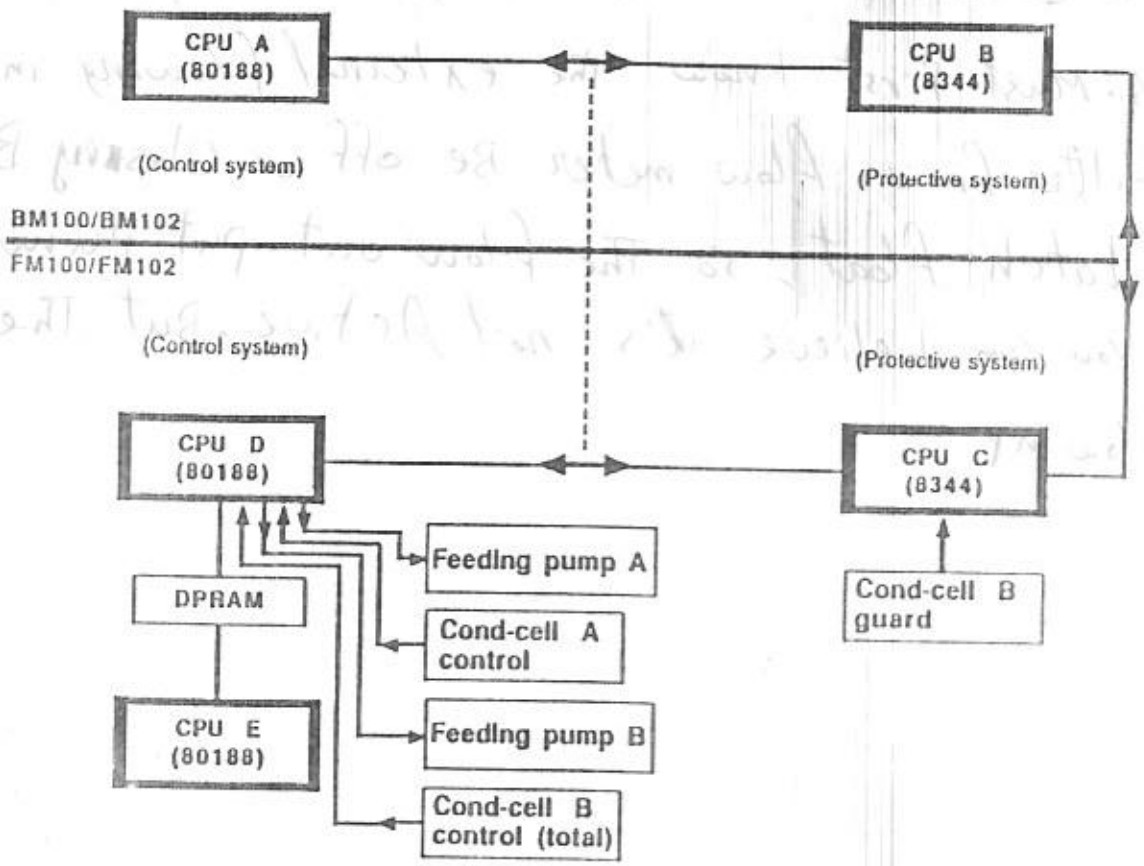


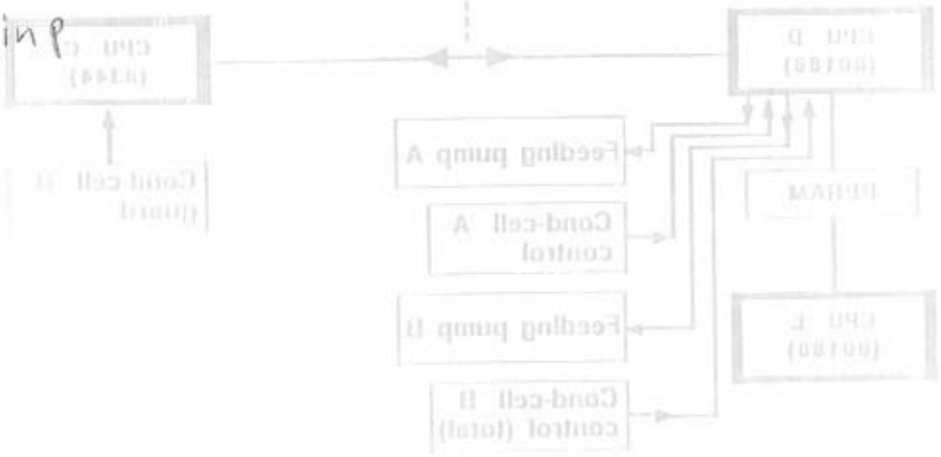
Fig.15. CONDUCTIVITY

Remark The flow out put pump used for taking or carrying the main flow in the fluid system to three diffrent flow Rates can be selected

300 , 500 , 800

- so to Calculate the uf by pressure control

You Must first know the external flowing in the filter frow flow meter Be off or Closing By Latch float, so the flow out put pump you can believe it's not Active, But the flow inp



Remark Flow input pump creating a negative pressure in the fluid system in order to get ultrafiltration from the Patient.

TMP AND UF-SYSTEM

The UF can be obtained in two (2) different ways:

1) By Pressure Control:

In **PRESSURE CONTROL** mode a negative pressure in the dialyzer is created by the **FLOW INPUT PUMP** if it runs faster than the **FLOW OUTPUT PUMP**. The pressure in the total fluid system is measured by a pressure transducer (Dialysate Pressure Transducer, **PD**).

The pressure value from the pressure transducer is fed into **CPU C, CPU D** and **CPU E.**

CPU E controls the speed of the **FLOW INPUT PUMP** according to the TMP that has been set.

Other pressure informations come from the **BM**: The venous pressure and/or the arterial pressure.

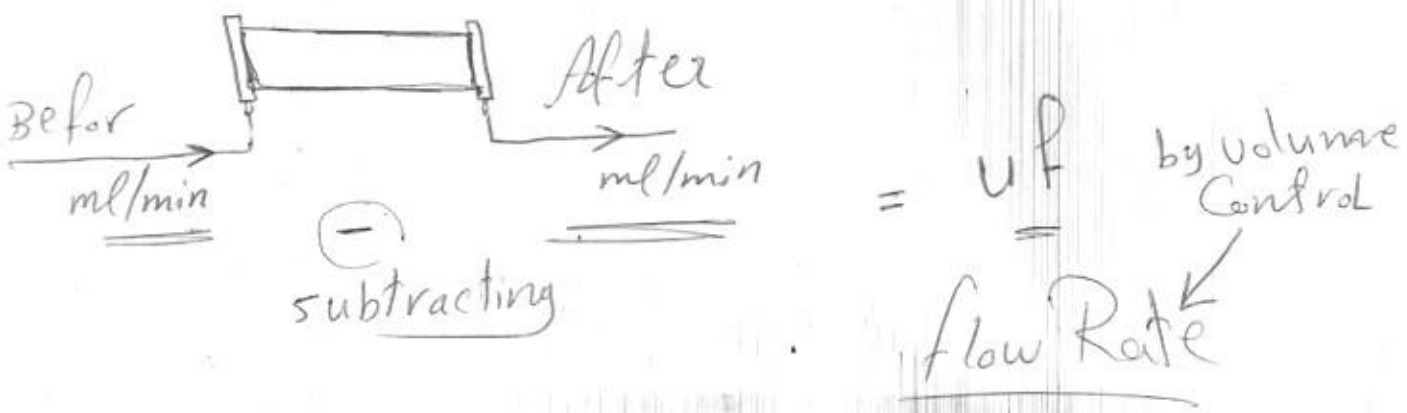
These pressures are added to the dialysis system pressure to **CPU D** via **CPU A** for calculation of the necessary negative pressure to get the requested TMP.

2) By Volume Control:

The UF can be controlled by measuring the flow rate through the two (2) channels in the UF-measuring cell.

In the flow path, channel no. 1 is measuring the flow rate before the dialyzer and channel no. 2 is measuring the flow rate after the dialyzer. The microprocessor is then subtracting these two (2) values from each other, and the result is the UF.

The **FLOW INPUT PUMP** speed is then regulated to obtain the desired UF.



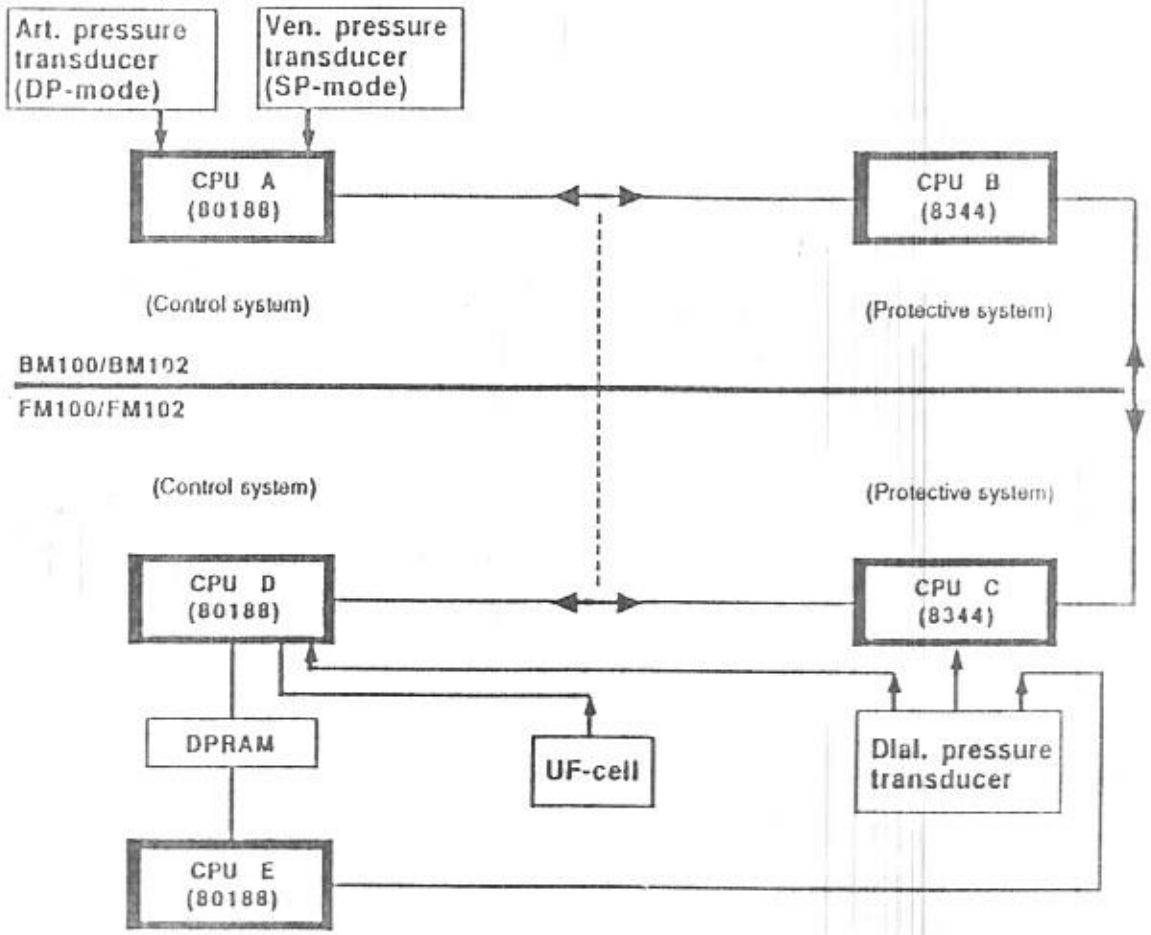


Fig.16. TMP AND UF-SYSTEM

DIRECT VALVE

Direct valve (DIVA) is the name of the valve which lets the fluid go out to the dialyzer.

To prevent the fluid to go out to the dialyzer in case of a malfunction in the machine, the direct valve is controlled in a special way. The **DIVA-logic** can be seen as a AND-gate with several inputs. It means that all inputs must agree to open the **DIVA-valve**.

The **DIVA-valve** is normally controlled from **CPU D**. Other signals comes from a so called **DIVA Bus** where the signals are connected together. If only one (1) of the circuits disagree to open the **DIVA-valve,** the valve will be closed and the fluid will be bypassed, i.e. the fluid is not passing through the dialyzer (= the patient is "disconnected" from the dialysis system).

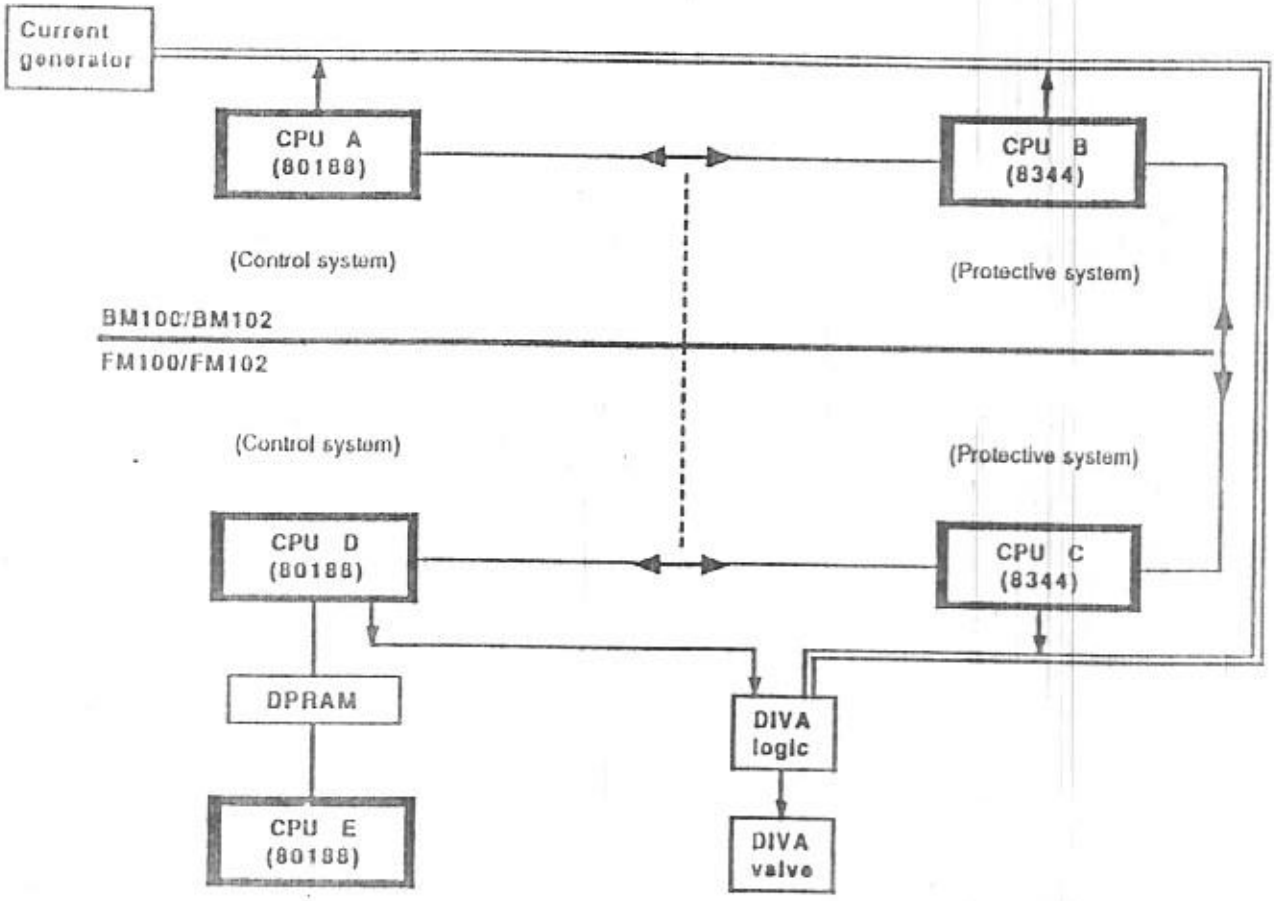


Fig.17. DIRECT VALVE

DEGASSING LEVEL REGULATION

After the **DEGASSING PUMP** there are more or less of air bubbles in the dialysate.

By filling up a chamber with this dialysate, the air bubbles will float up to the top. If the same chamber has an outlet in the bottom the outlet fluid will be without air bubbles.

The fluid level in the chamber is controlled by means of a crystal, used as transmitter and receiver for a pulse of high frequency.

CPU D outputs a pulse to the crystal, placed in the bottom of the chamber. This will create an ultra sonic sound pulse that goes up to the surface of the fluid level and comes back again after a time, depending on the distance between the crystal and the fluid surface. The micro-processor then **converts the time into length**.

To keep the level constant in the chamber, a stepper motor is controlling a **RECIRCULATION VALVE** which is opening or closing the valve.

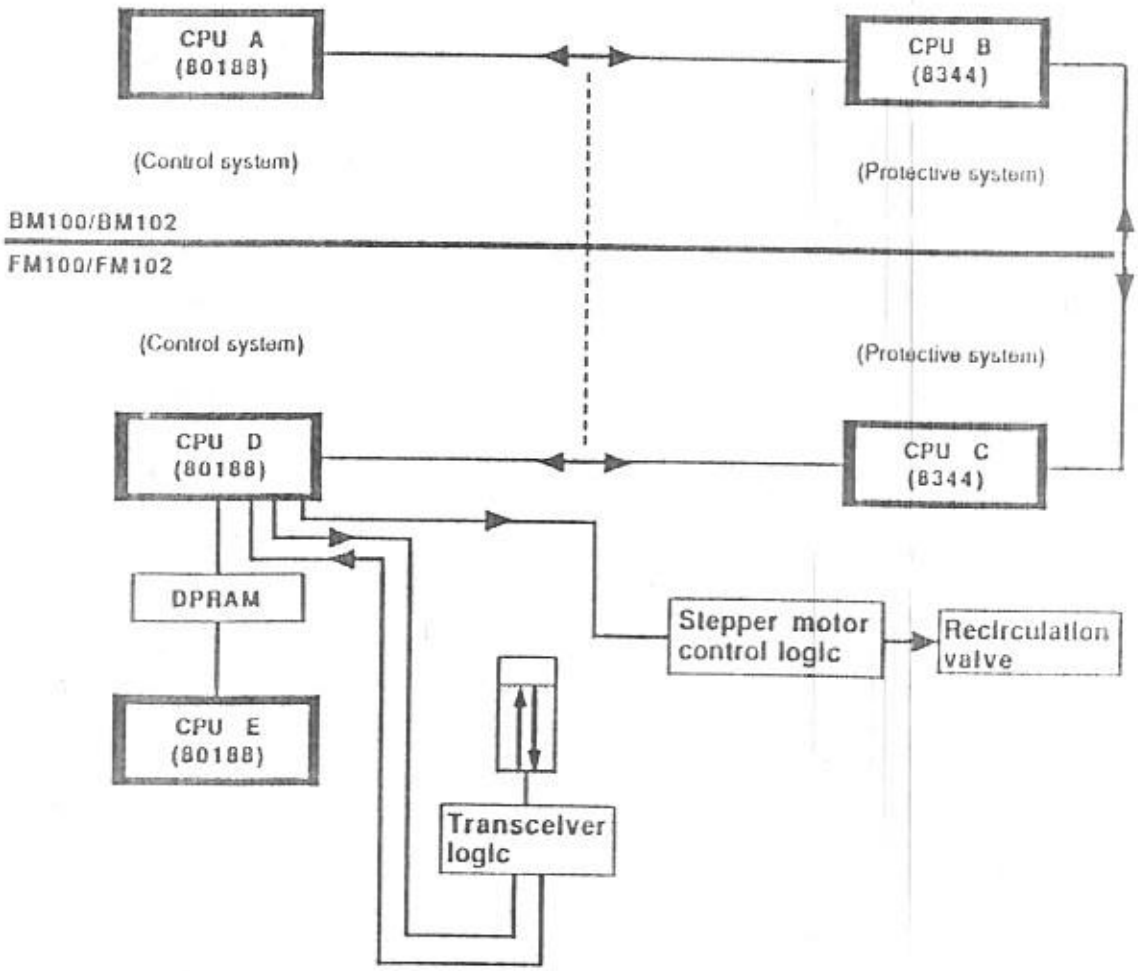


FIG.18. DEGASSING LEVEL REGULATION

DEAIRATING LEVEL REGULATION

There might be some air in the fluid system, coming from the dialyzer or the tubings.

By filling up a chamber with this dialysate, the air bubbles will float up to the top. If the same chamber has an outlet in the bottom, the outlet fluid will be without air bubbles.

The fluid level in the chamber is controlled by means of a crystal, used as transmitter and receiver for a pulse of high frequency.

CPU D outputs a pulse to the crystal, placed in the bottom of the chamber. This will create an ultra sonic sound pulse that goes up to the surface of the fluid level and comes back again after a time, depending on the distance between the crystal and the fluid surface. The micro-processor then **converts the time into length**.

To keep the level constant in the chamber, an **EVACUATION VALVE (EVVA)** opens or closes. When open, the air is exchanged with fluid.

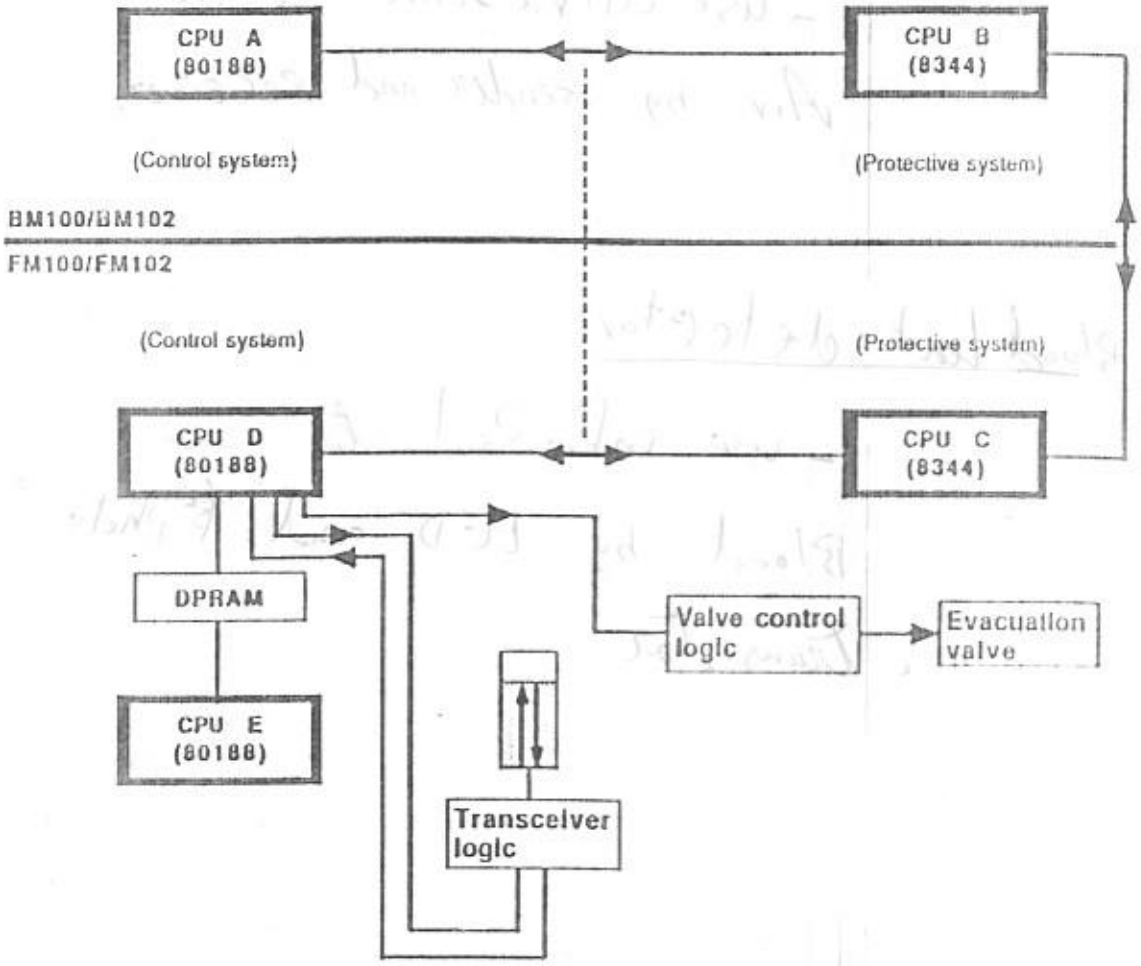


FIG.19. DEAIRATING LEVEL REGULATION

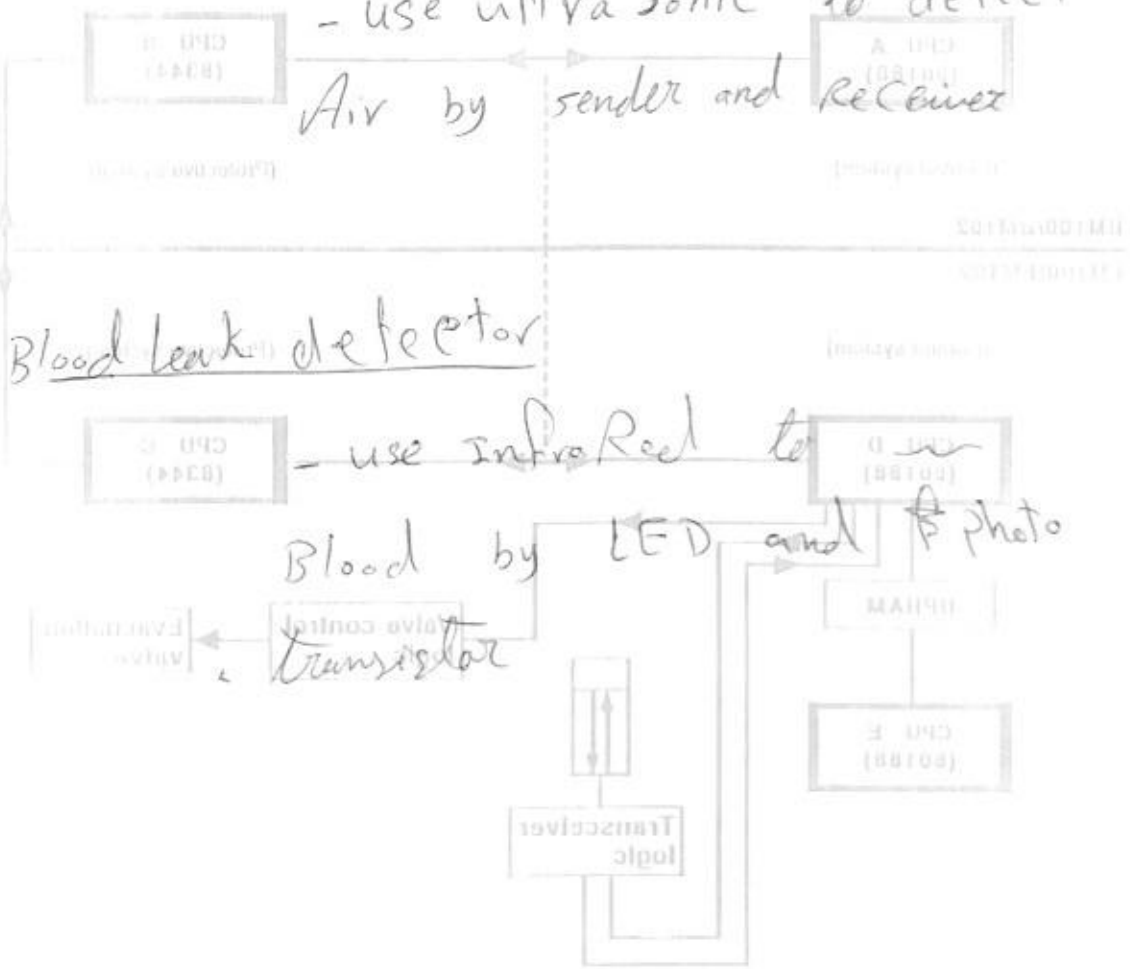
Important Noting

Air bubble Detector

- use ultra sonic to detect Air by sender and receiver

Blood leak detector

- use Infra Red to Blood by LED and photo transistor



BLOOD LEAKAGE DETECTION

Only CPU C is involved in the **BLOOD LEAKAGE DETECTION** system.

An **infra red light emitting diode (LED)** is supplied from a current generator in order to keep the current constant. The light from the **LED** is passing through a blood leak detector house to a photo transistor. The current through this transistor is proportional to the strength of the light beam. This current value is converted into a voltage and fed to **CPU C**. In case of a blood leak in the dialyzer, the strength of the light beam will decrease, i.e. the current through the transistor will decrease, and **CPU C** gets a lower value which indicates that there is a blood leakage.

CPU C sends out an alarm signal to **CPU A** via **CPU B** in order to start the alarm circuit.

There is also a **blood leakage detection test** during the treatment. Every five (5) minute, **CPU C** outputs a test signal **"Blood Leakage Detector Enable" (BLDE)** with a duration of 10 seconds. This signal turns off the light from the **LED**. Since this is only a function test, **the alarm is bypassed during the test**.

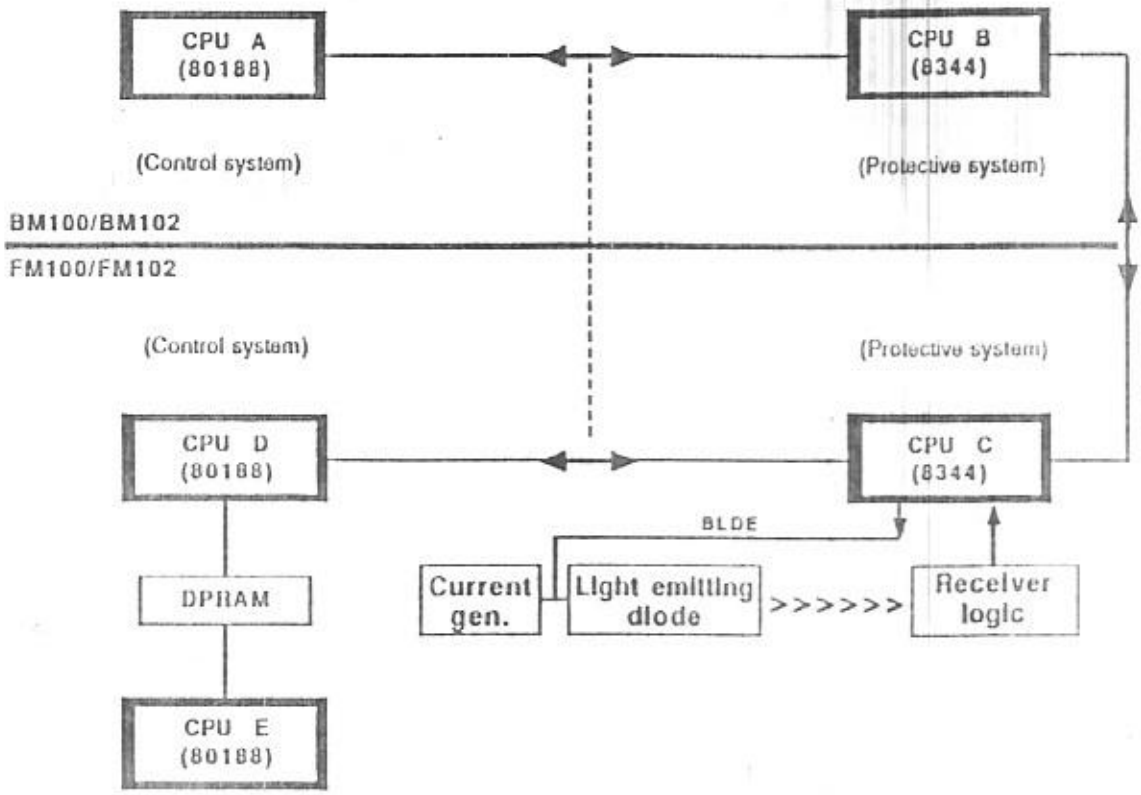


Fig.20. BLOOD LEAKAGE DETECTION

CONCENTRATE TUBE SENSORS

The concentrate tube sensors are used to detect whether concentrate tubes "A" and/or "B" are placed in the heating vessel or not. This information is important for the micro-processor because in some modes are only one (1) concentrate tube used, in other modes, like **Bicarbonate/BiCart,** two (2) tubes are used. When the machin is used for patient treatment, i.e. in **Acetate Mode**, the right concentrate tube **(tube "B")** must be placed in the concentrate container. Also for **Disinfection Mode,** it's important to use the right tube.

The informations from the tube sensors are fed to **CPU D**.

If the concentrate tubes are used in a wrong way, an **ATTENTION ALARM** will appear on the **information display** on the instrument panel.

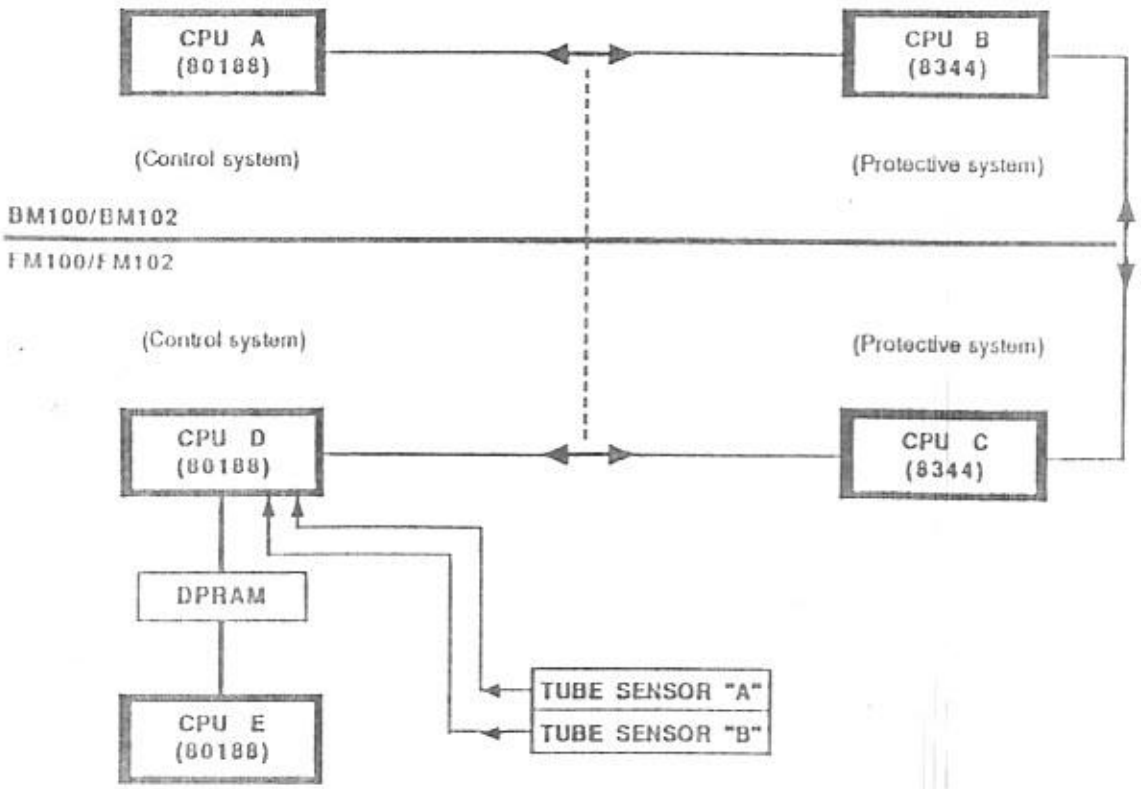


Fig.21. CONCENTRATE TUBE SENSORS

pH-UNIT

As the name says, the **pH-Unit** is used for measuring of the **pH-Value** in the dialysis fluid.

It is also used for checking if the right kind of concentrate is used, especially in **Bicarbonate/BiCart mode** where two (2) different concentrate types are used. Even if the total conductivity value shows the right value, the **pH-Value** can be wrong.

The output from the **pH-Unit** is a pulse with a frequency proportional to the **pH-Value** and fed into **CPU D**.

The output from the **pH-Unit** is galvanic isolated from the input **for patient safety reasons**.

pH alarm limits can be set by the operator in order to bypass the fluid to the dialyzer in case of a malfunction in the machine.

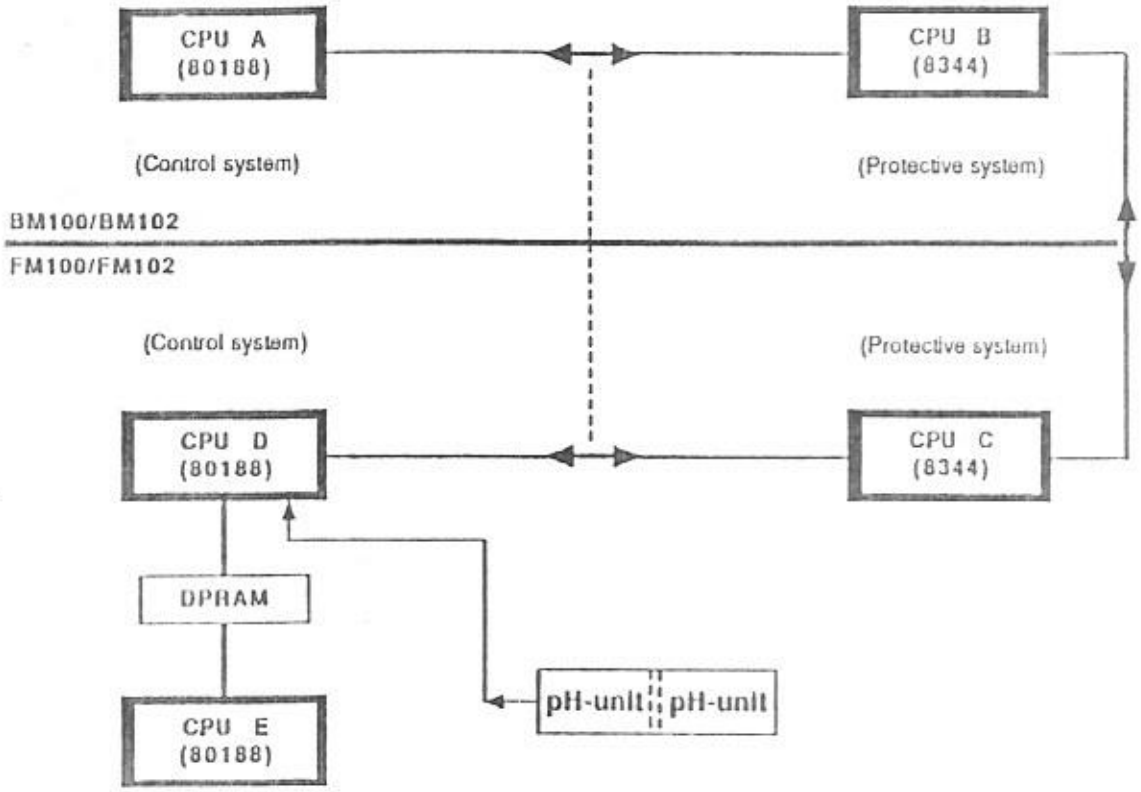


Fig.22. pH-UNIT

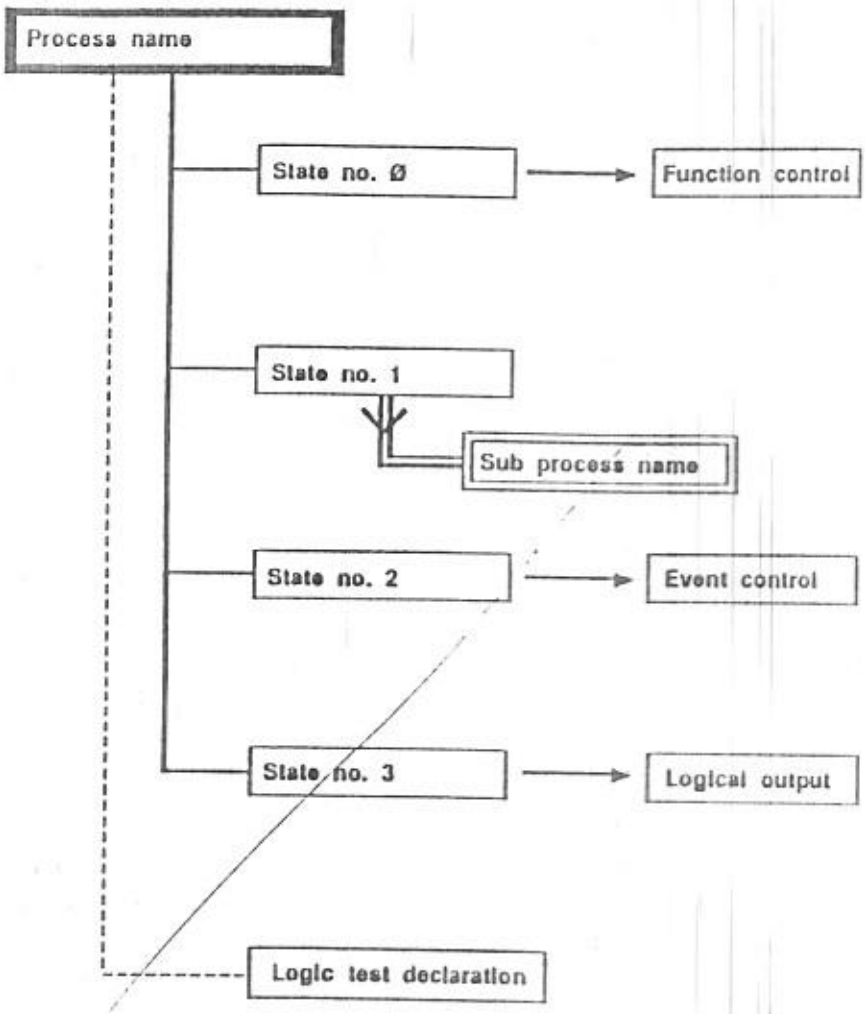


Fig.23. SOFTWARE

BM

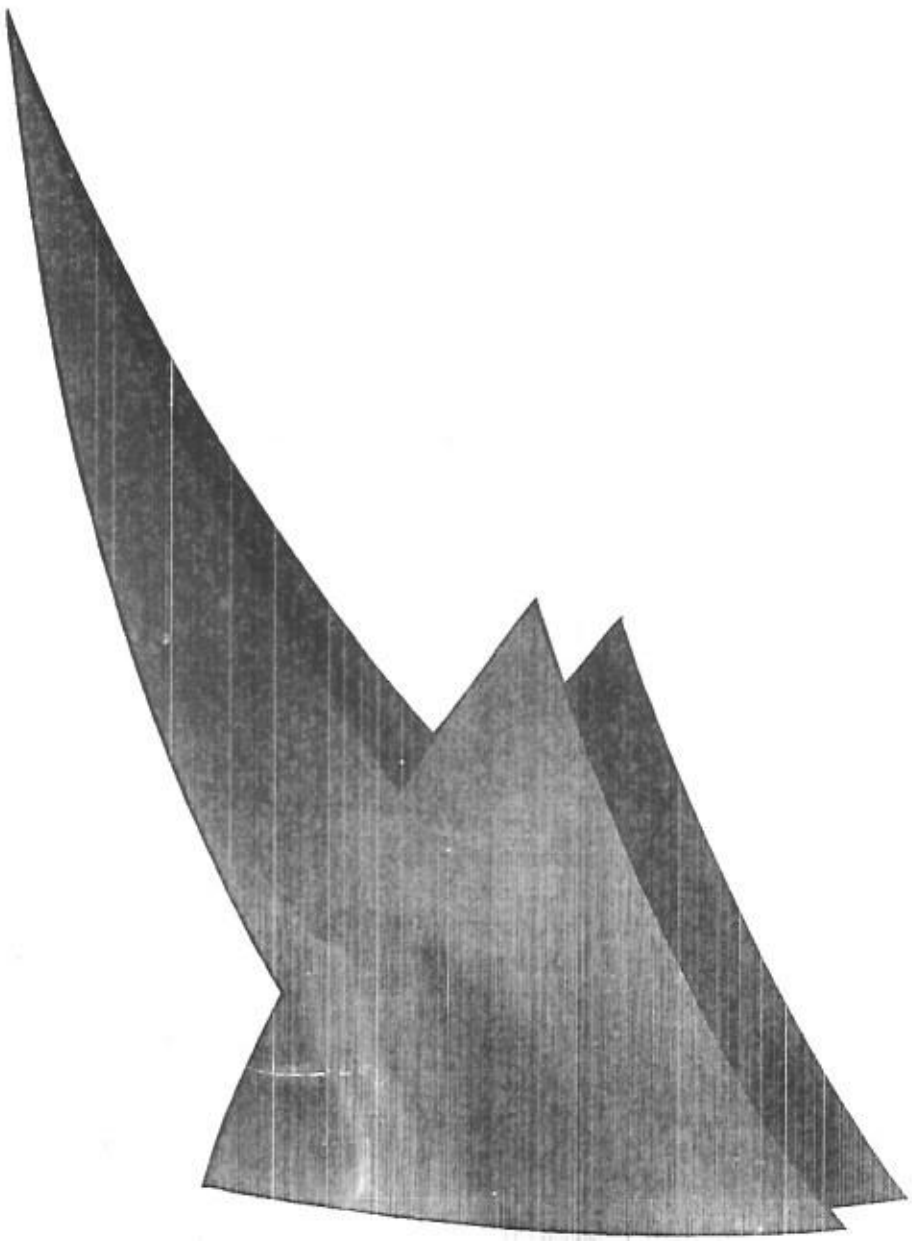
- SINGLE NEEDLE
- DOUBLE NEEDLE
- SINGLE NEEDLE DOUBLE PUMP

FM

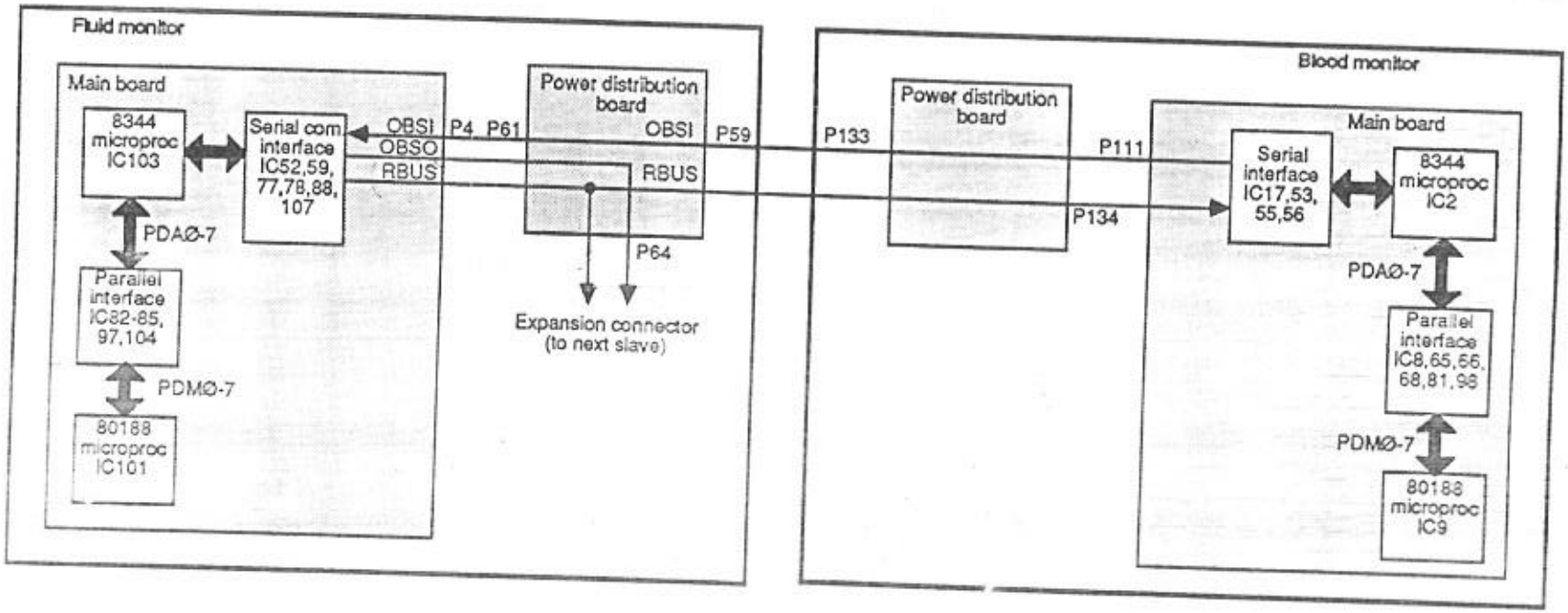
- FLOW DIAGRAM (ACETATE MODE)
- FLOW DIAGRAM (BICARBONATE MODE)
- FLOW DIAGRAM (BICART MODE)
- TUBING IDENTIFICATION

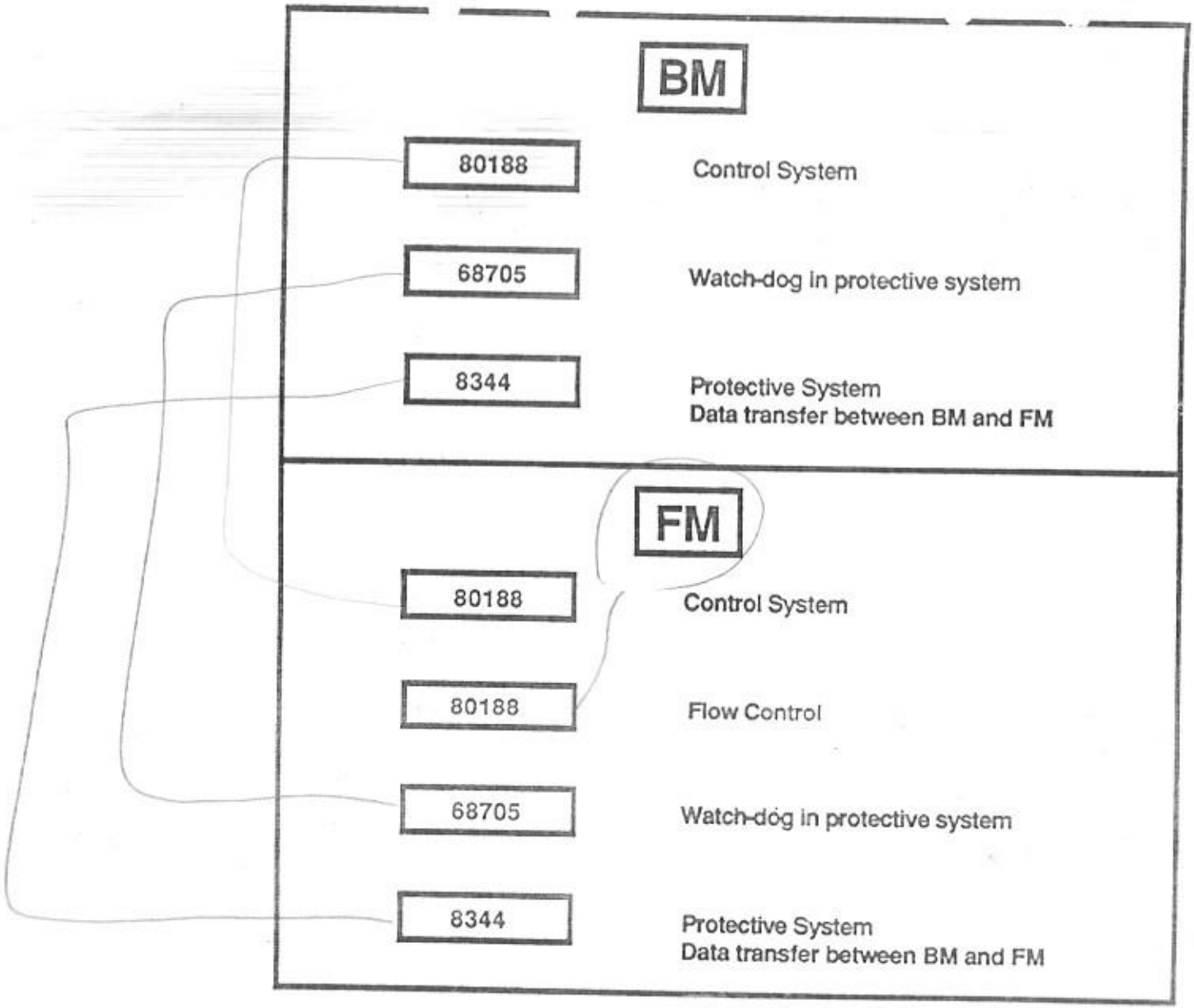
- ERROR CODES, EXPLANATION AND EXERCISE
- LIST OF SIGNALS AND DESTINATIONS

FM SIGNAL BOARD LIST

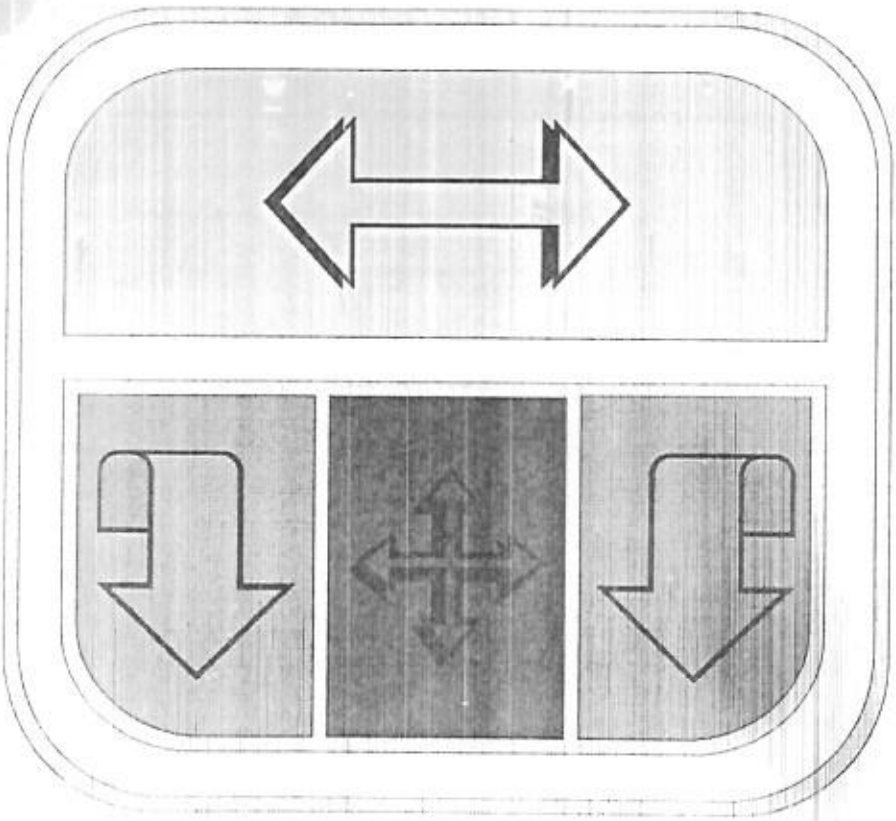


Serial and Parallel Communication Interface

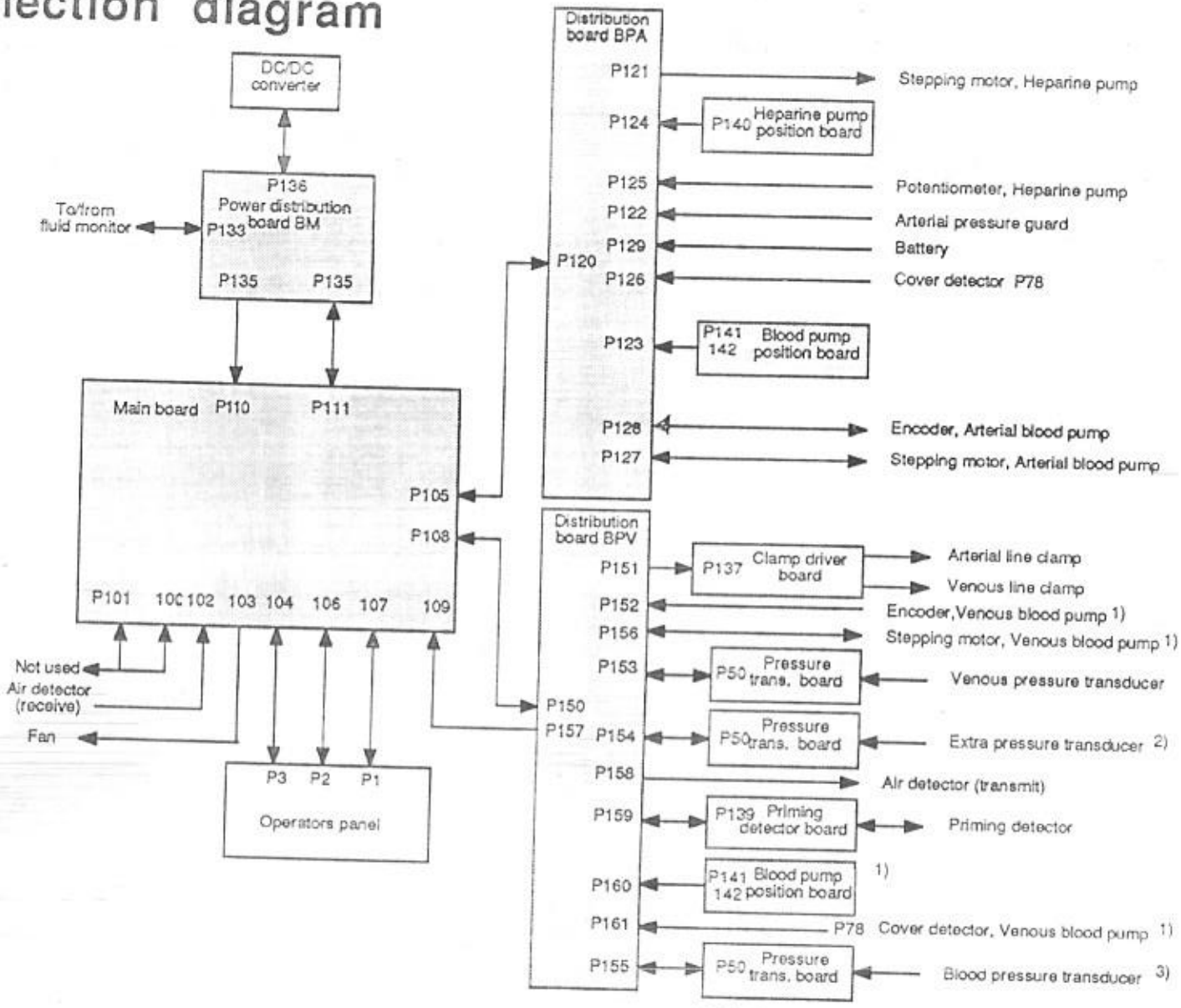



BM
80188
Control System
68705
Watch-dog in protective system
8344
Protective System
Data transfer between BM and FM
FM
80188
Control System
80188
Flow Control
68705
Watch-dog in protective system
8344
Protective System
Data transfer between BM and FM

BM BLOCK DIAGRAM

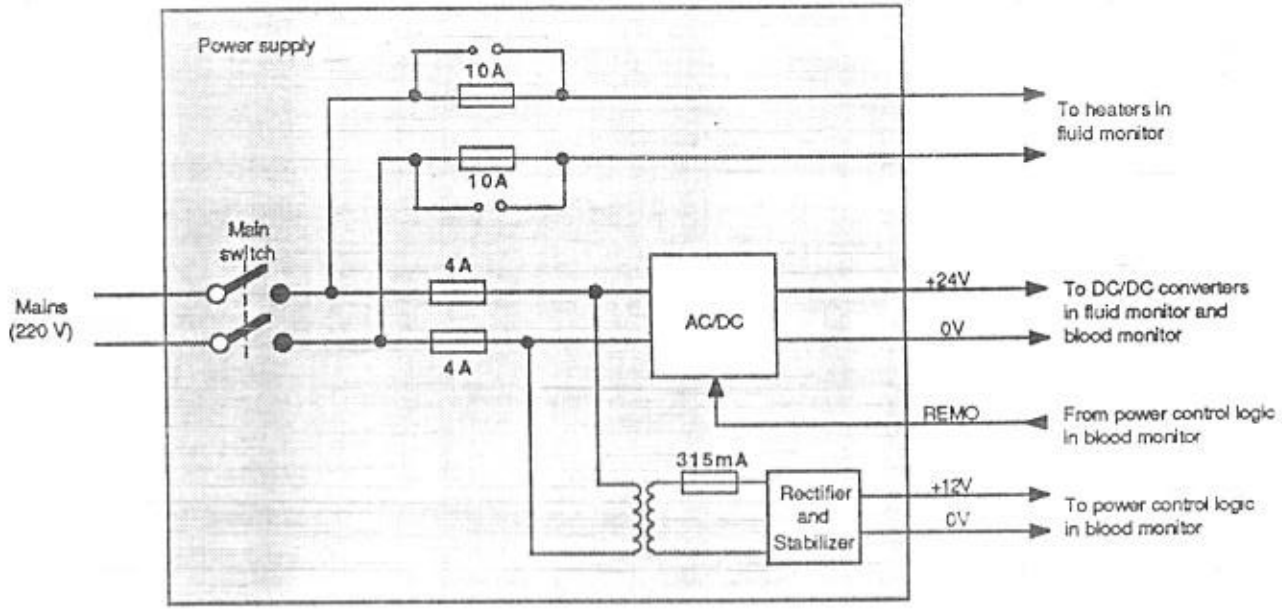


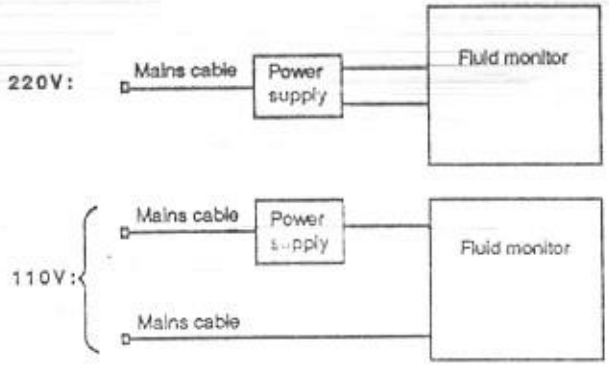
Connection diagram



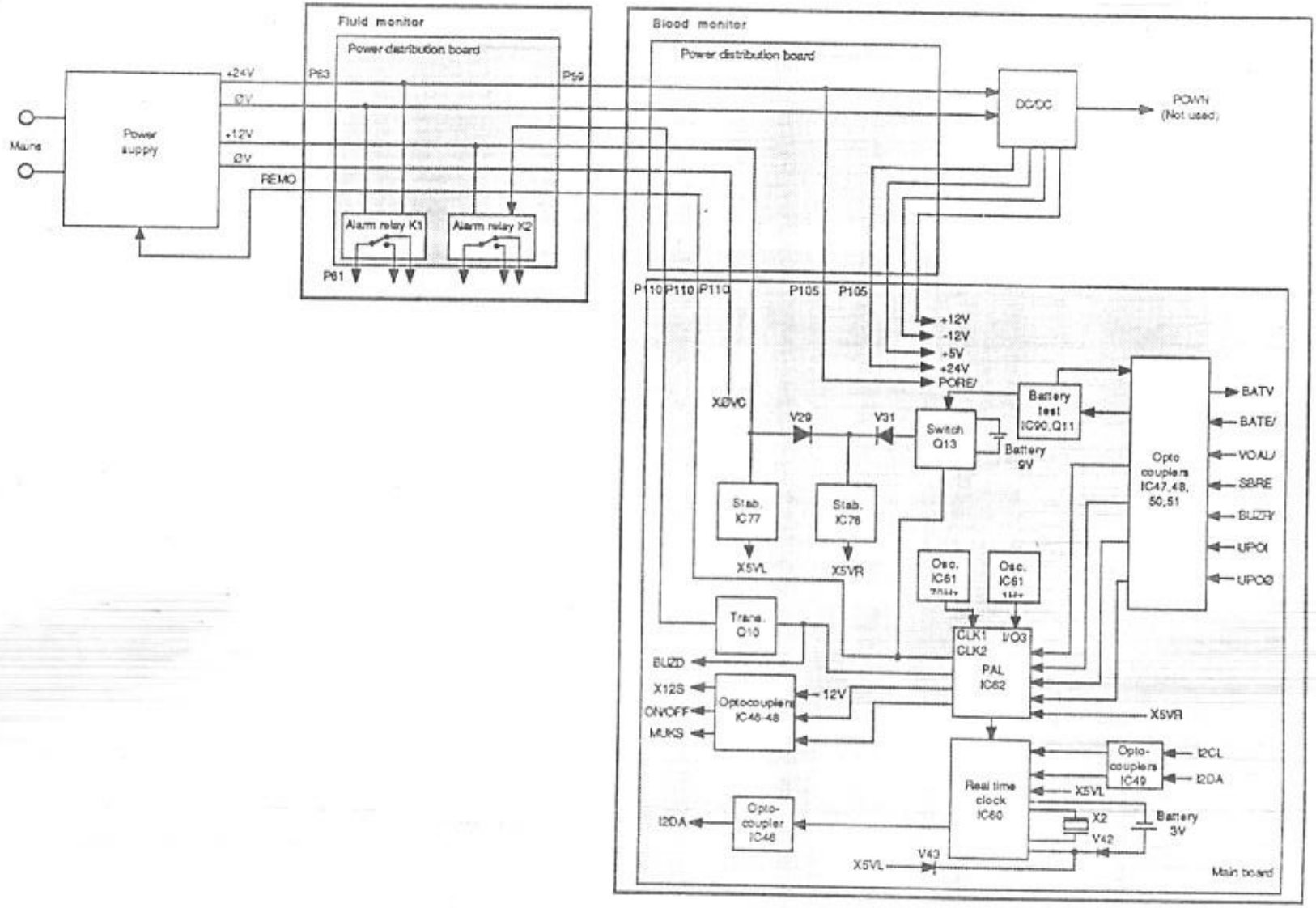
1) BM 102 2) Optional in BM100/102 3) Optional in BM100

,wer Control


Power supply
10A
10A
Main switch
4A
4A
Mains (220 V)
AC/DC
+24V
0V
To heaters in fluid monitor
To DC/DC converters in fluid monitor and blood monitor
REMO
From power control logic in blood monitor
315mA
Rectifier and Stabilizer
+12V
0V
To power control logic in blood monitor

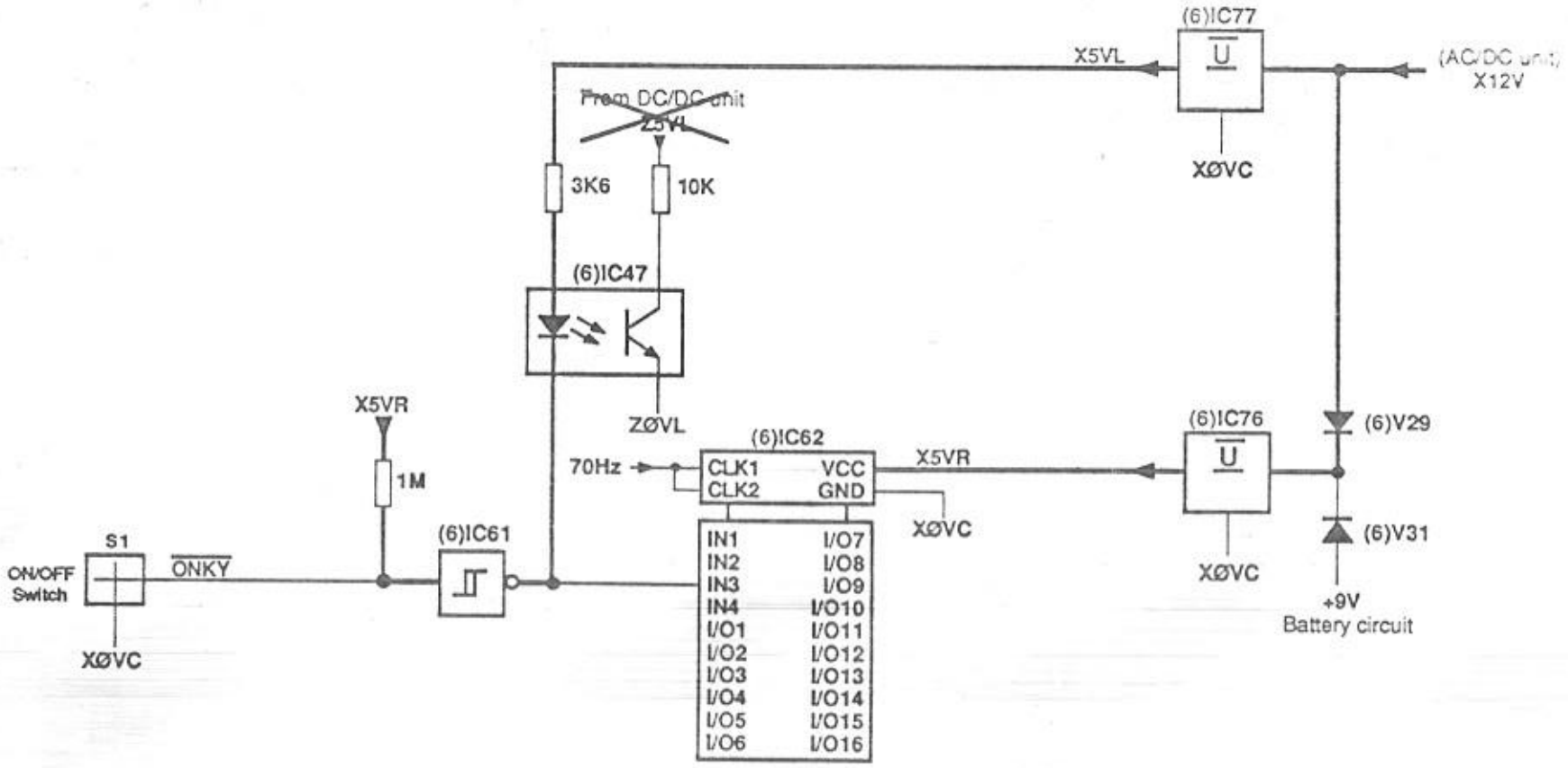

220V:
Mains cable
Power supply
Fluid monitor
110V:
Mains cable
Power supply
Mains cable
Fluid monitor

ower control logic



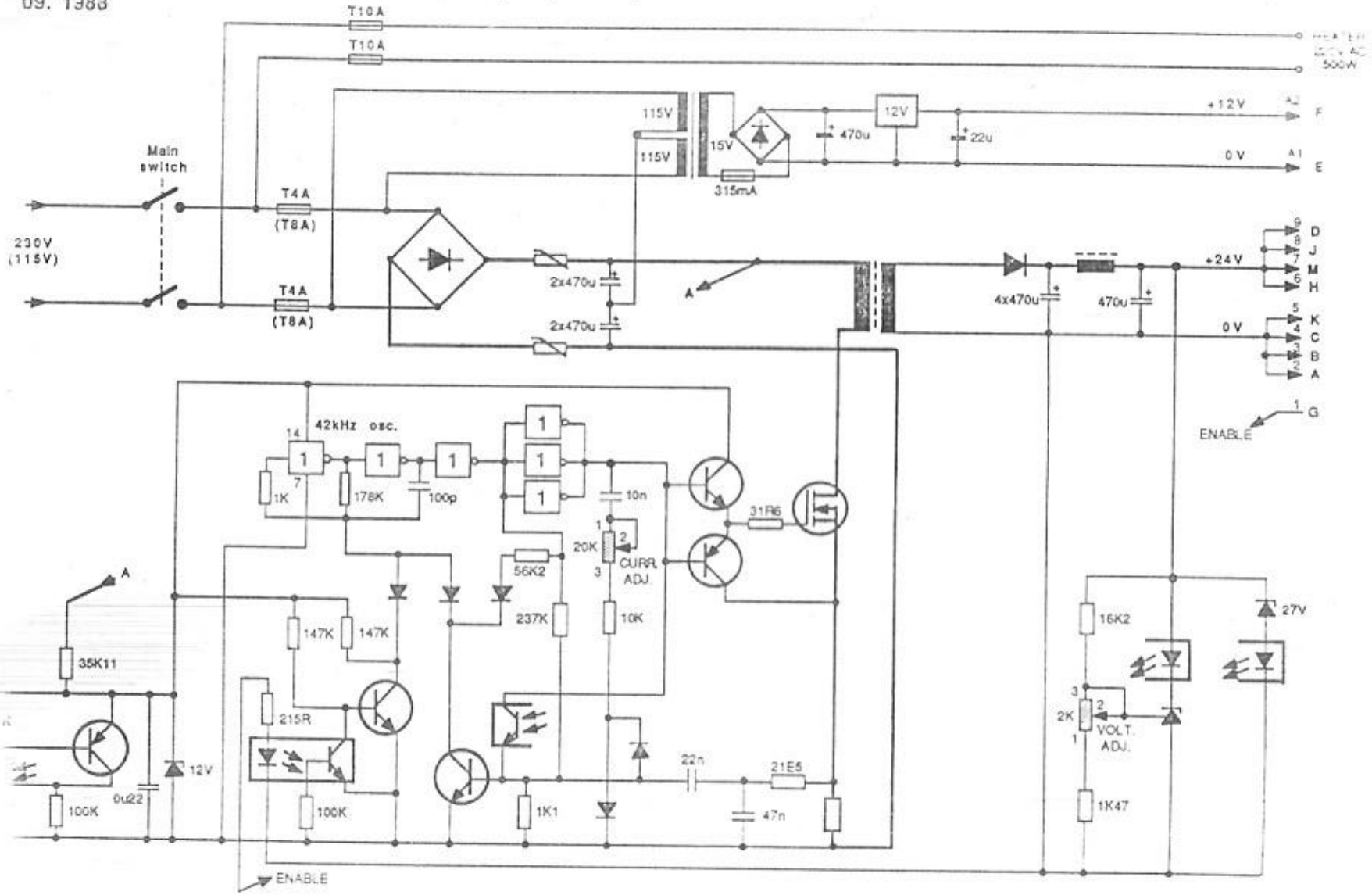
100 BM ON/OFF function (Switching ON AC/DC)

7. 1988



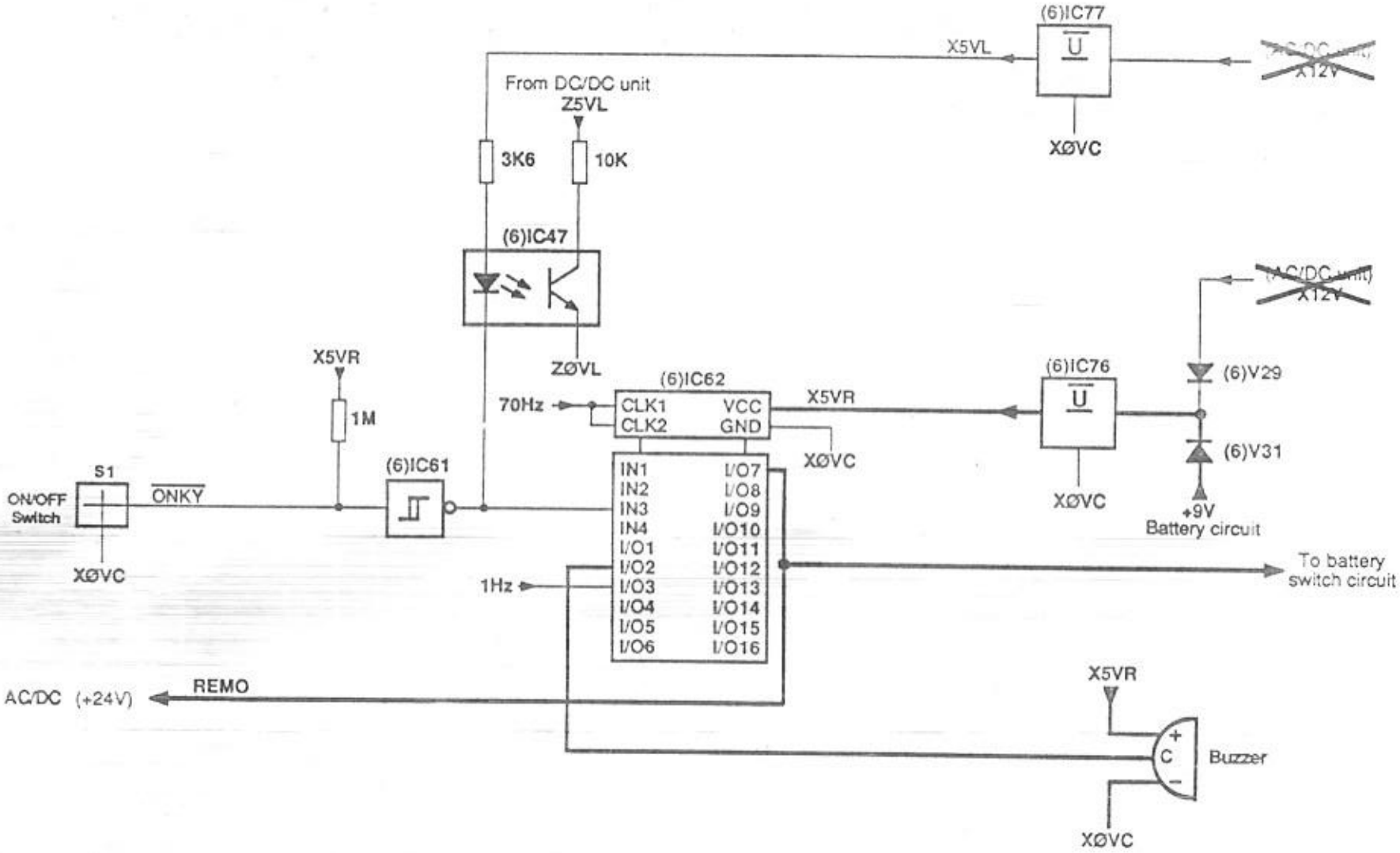
K 100 AC/DC-unit (simplified)

09. 1988



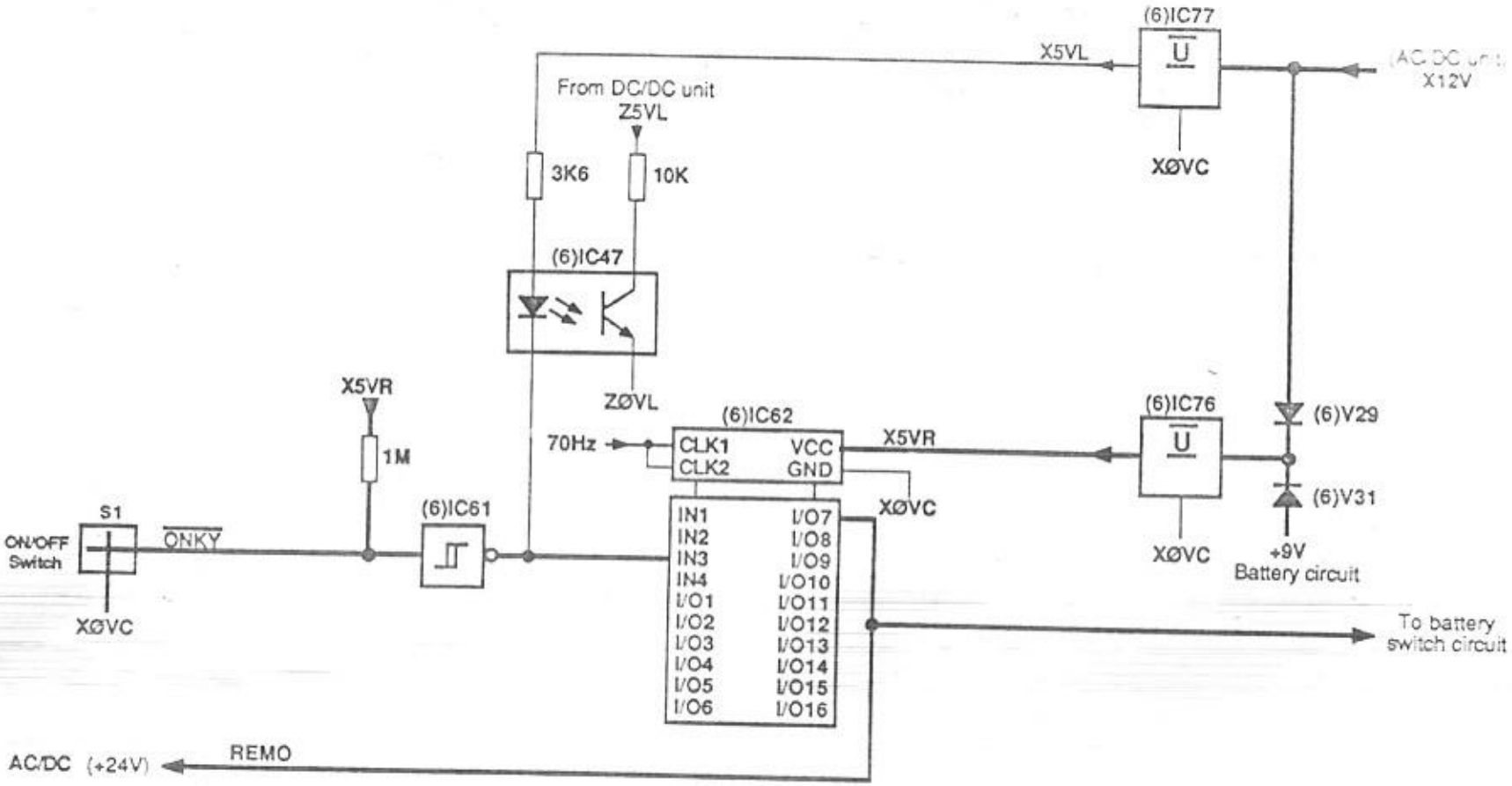
100 BM ON/OFF function (AC/DC ON, Power failure)

. 1988



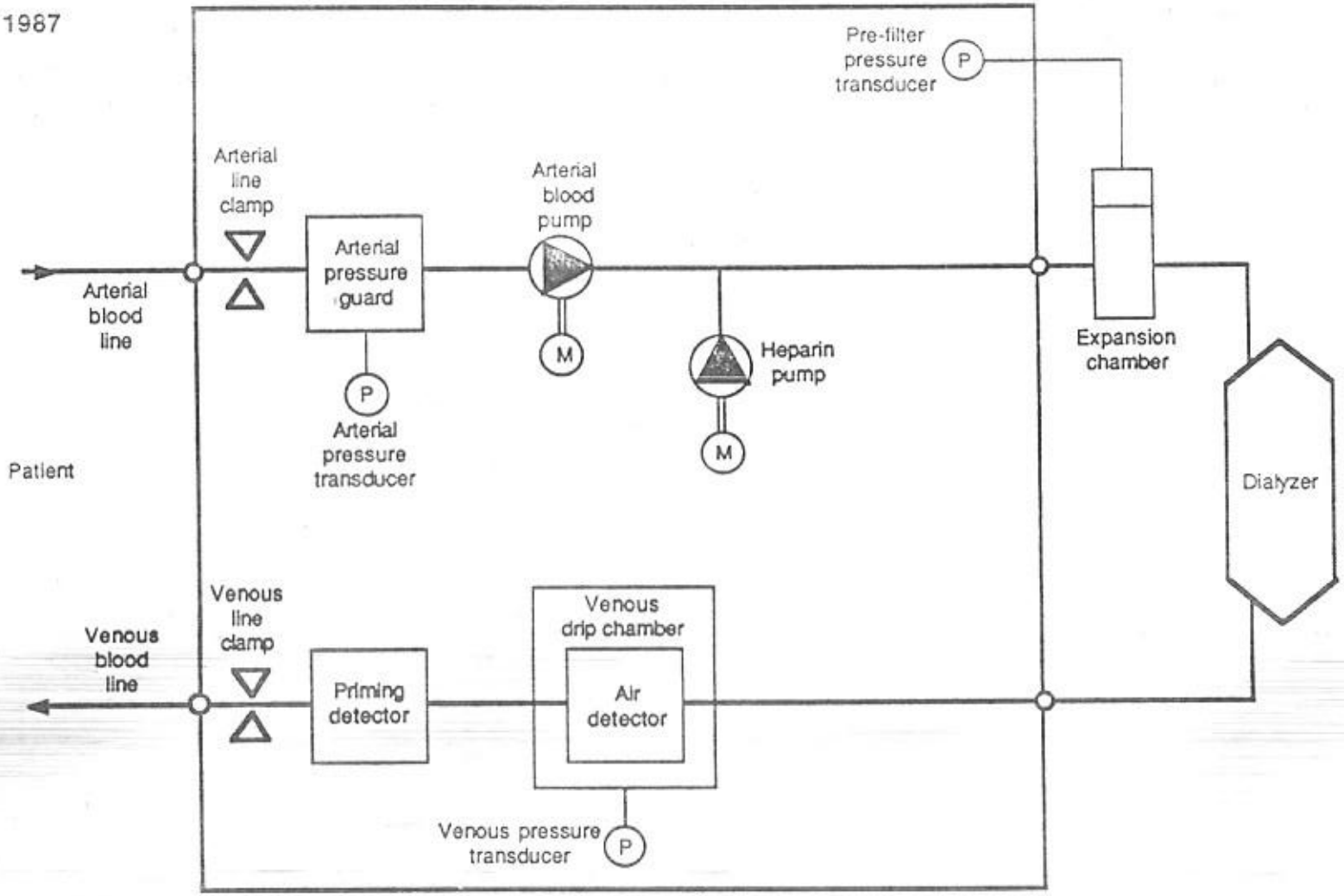
100 BM ON/OFF function (AC/DC ON, Switching ON AK 100)

07. 1988



BM 100 Flow diagram

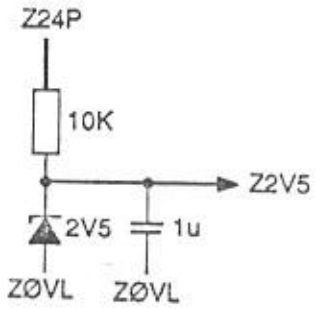
B.O. 06. 1987

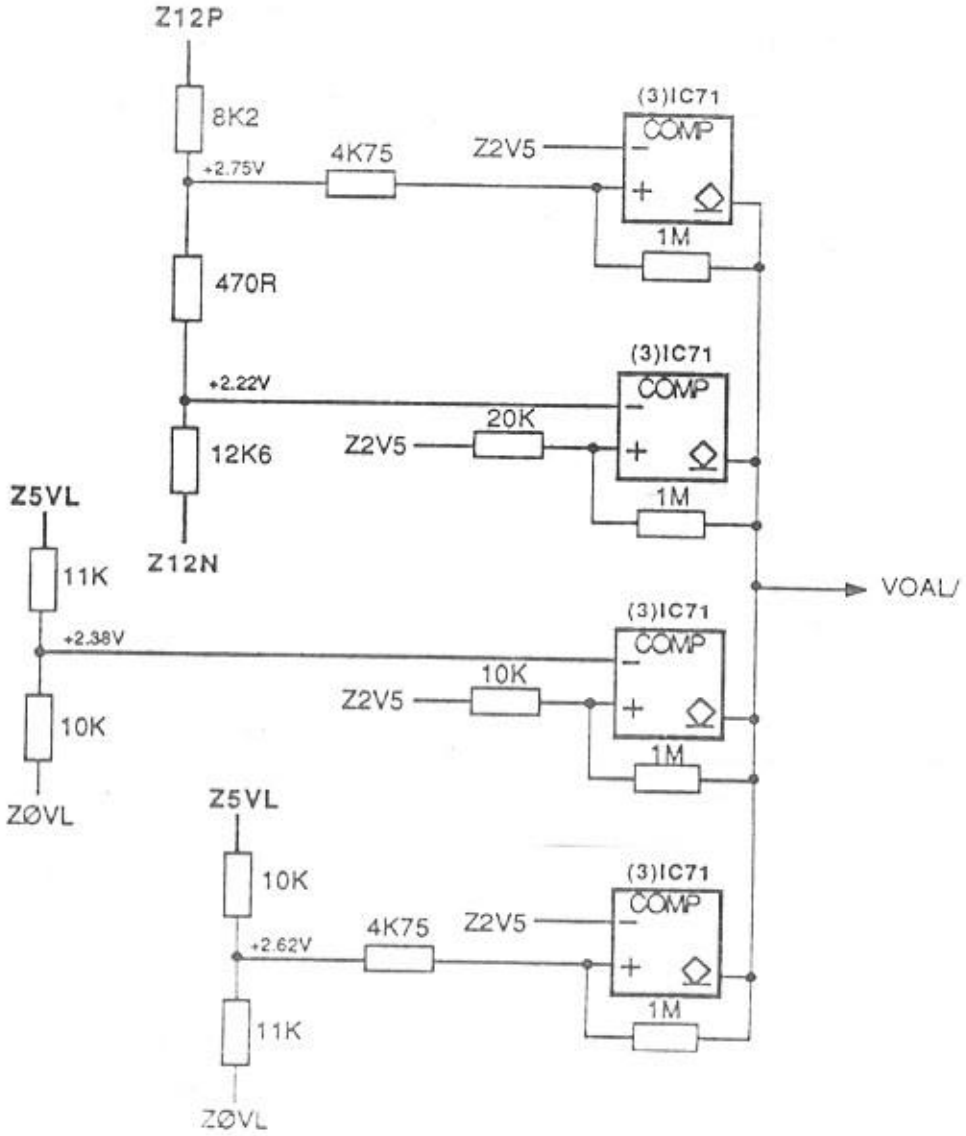


Dubble-Needle treatment

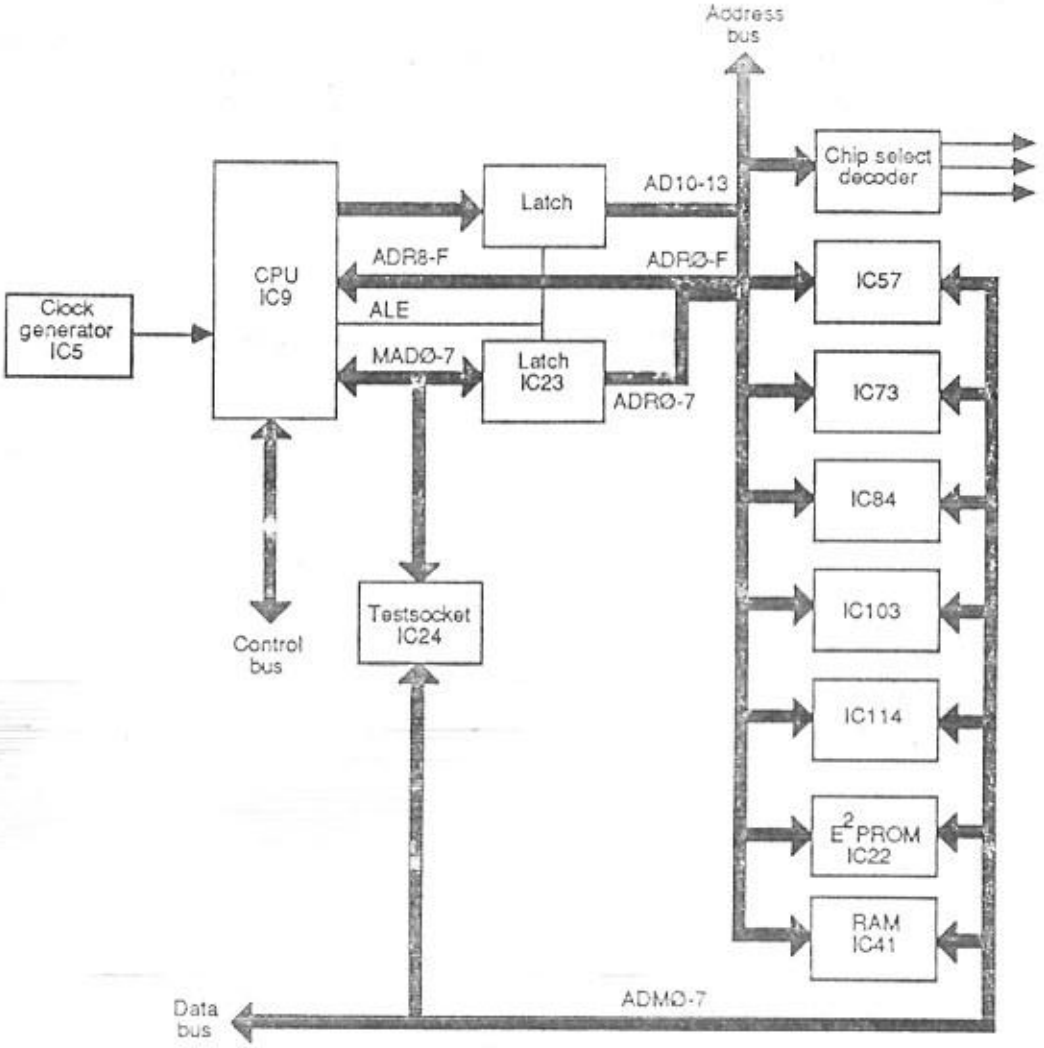
AK 100 BM Supply voltage monitoring

d.O. 05. 1987



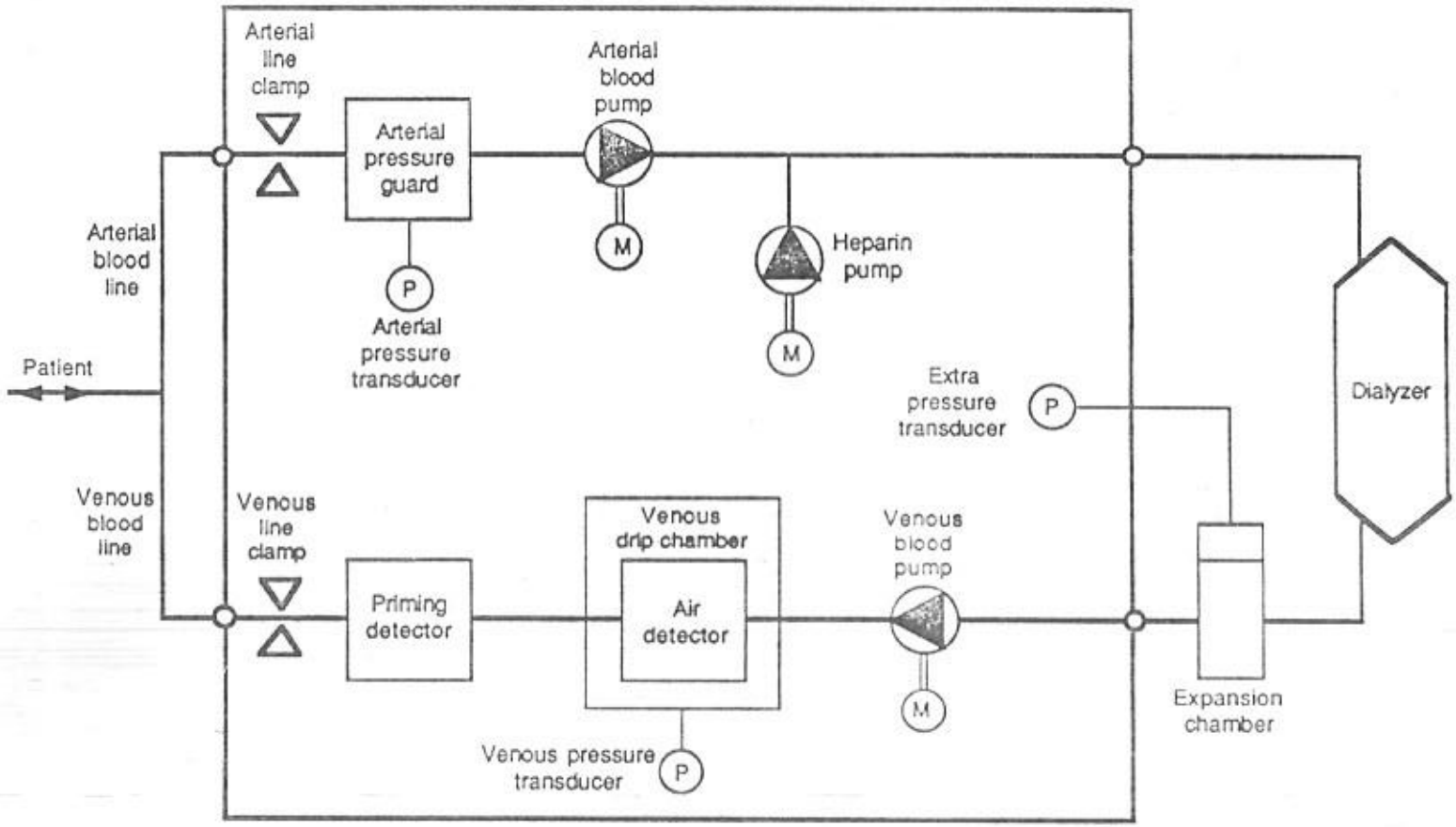


Microprocessor (Control system)

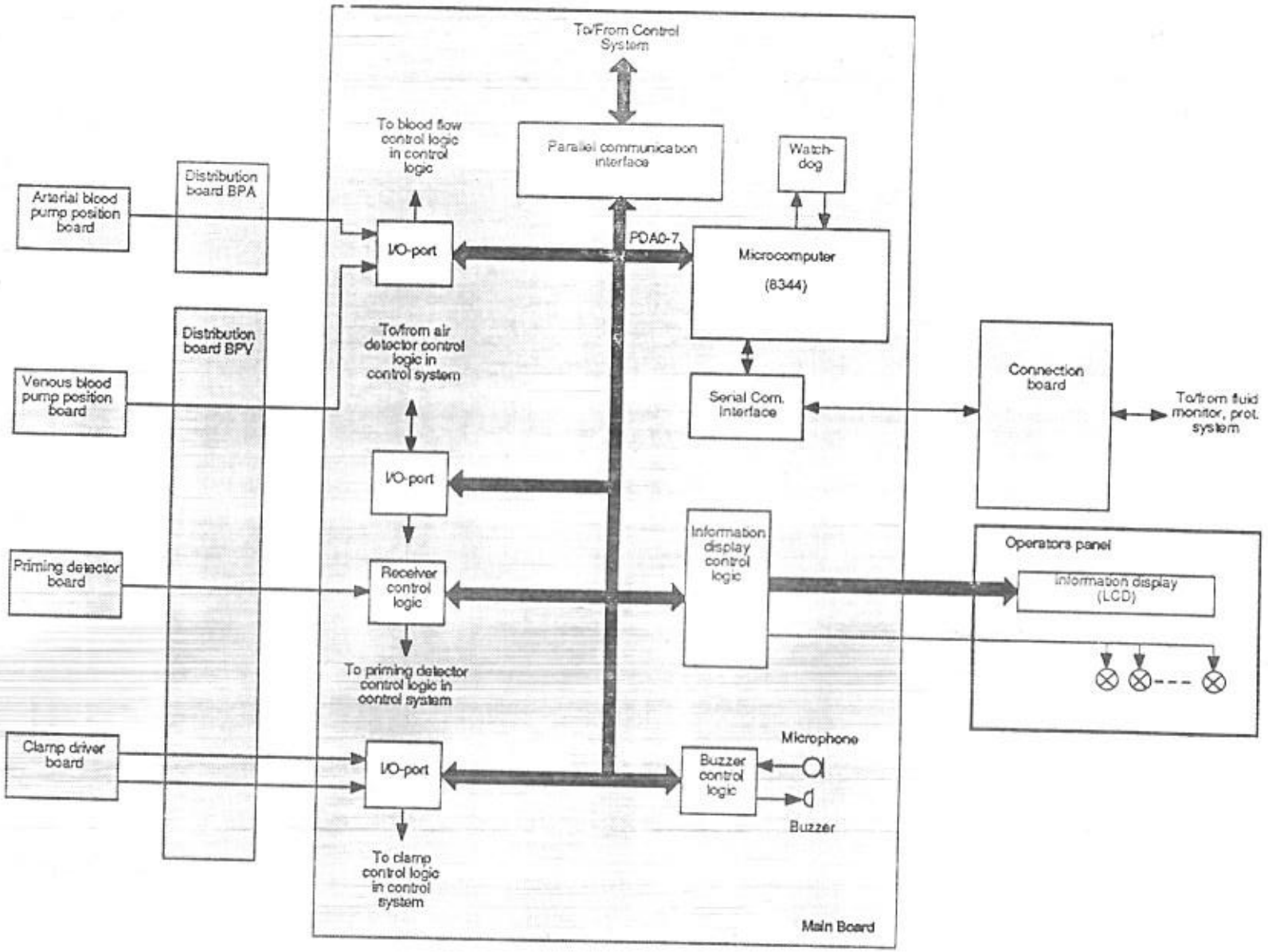


BM 102 Flow diagram

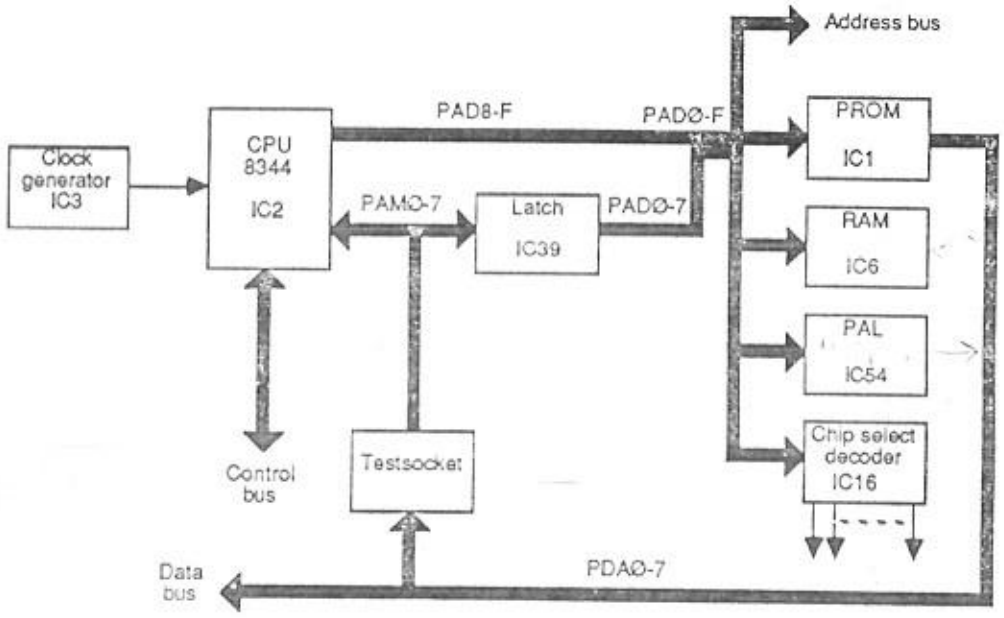
B.O. 06. 1987



Protective system

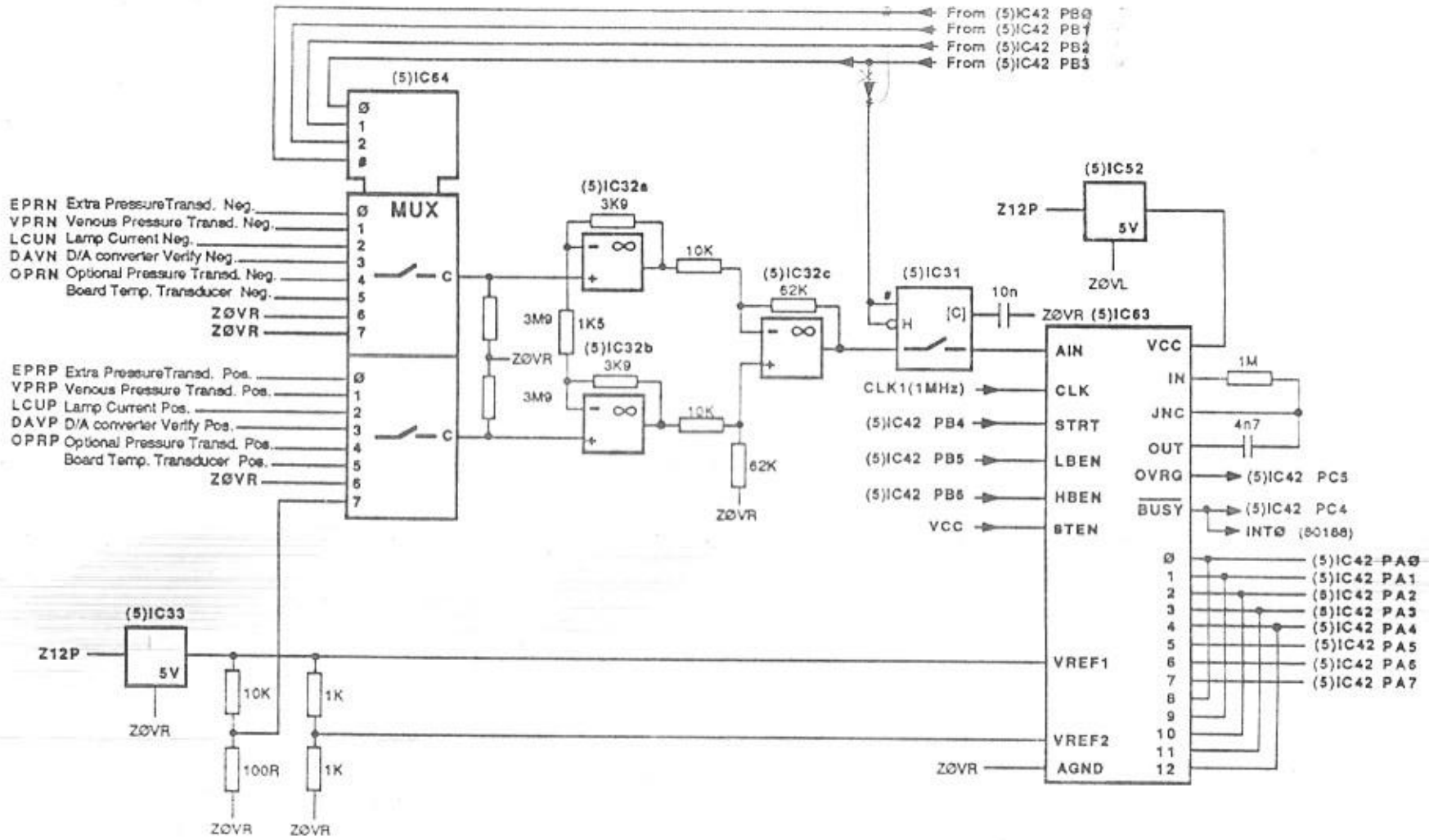


Microcomputer (Protective System)

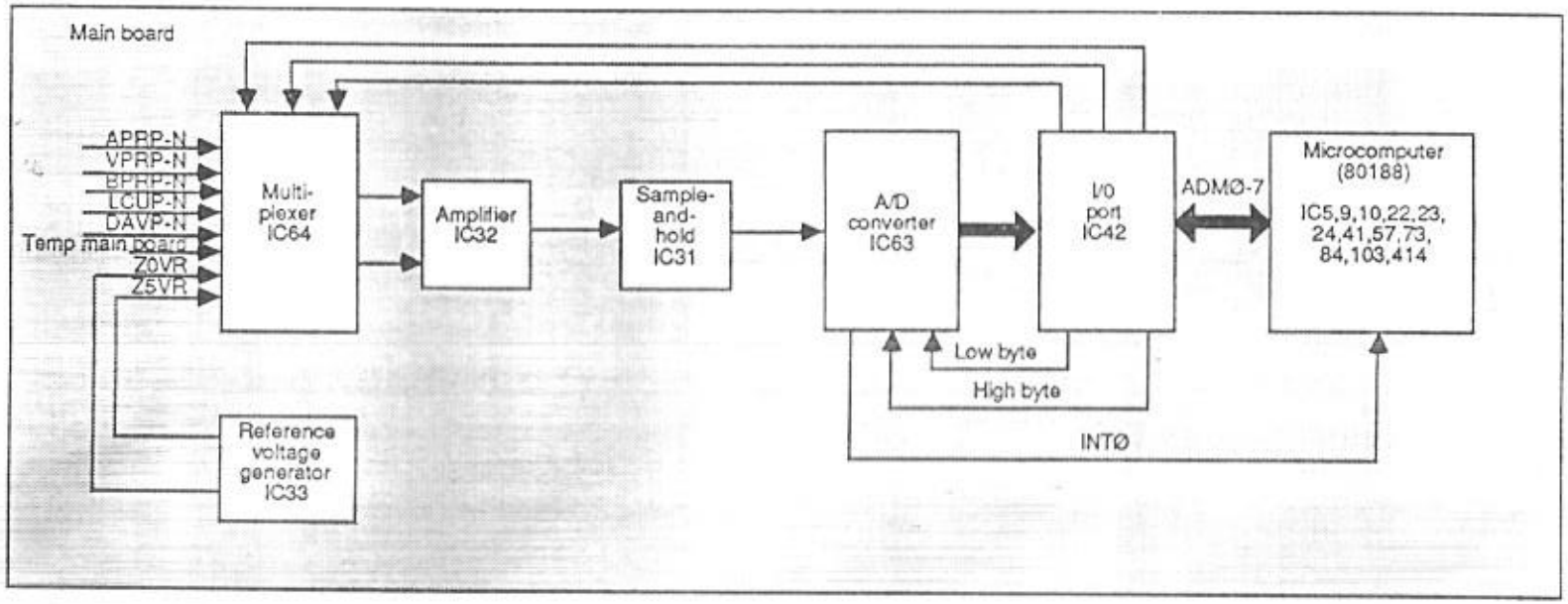


AK 100 BM A/D system

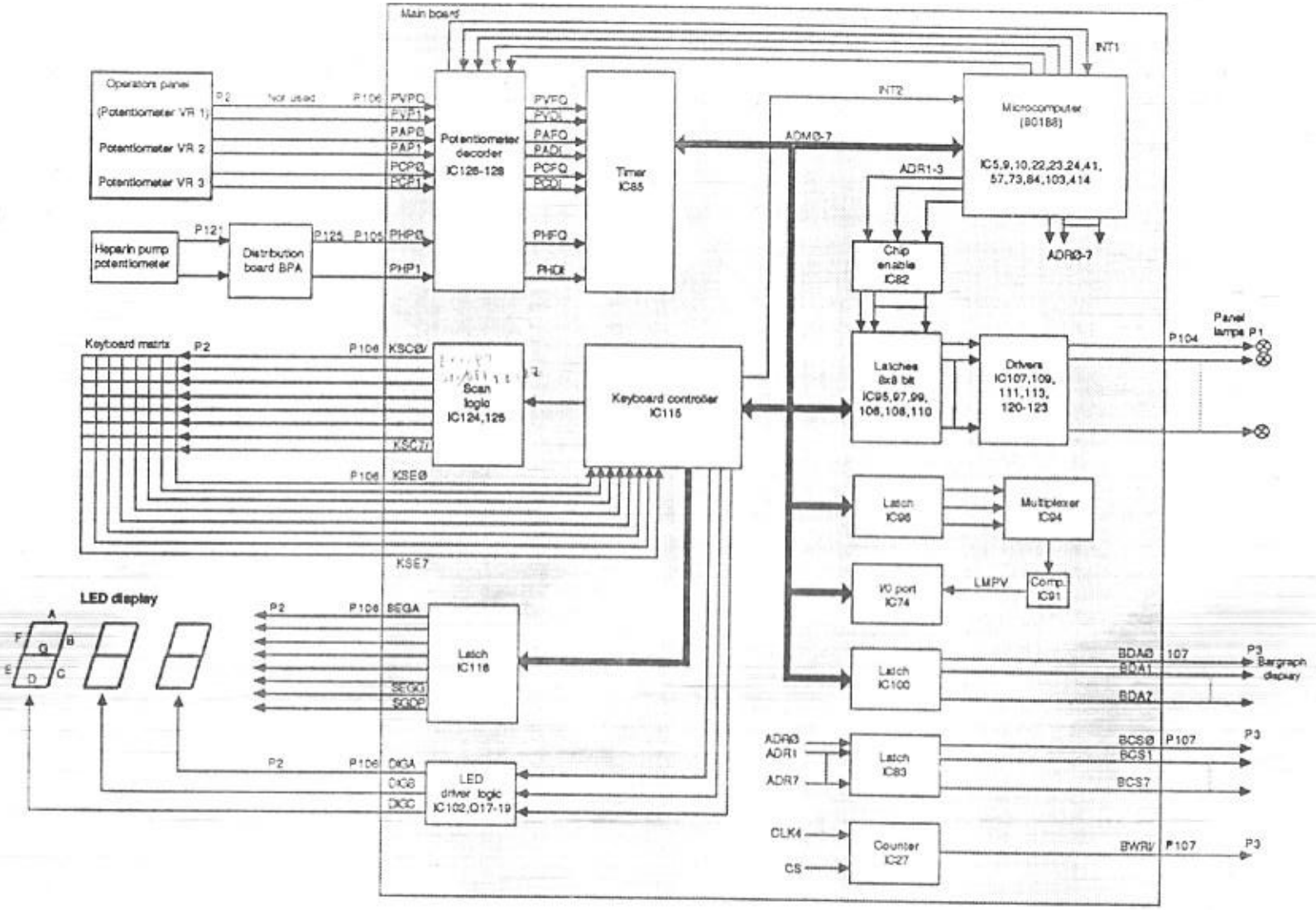
B.O. 02. 1988



A/D-system

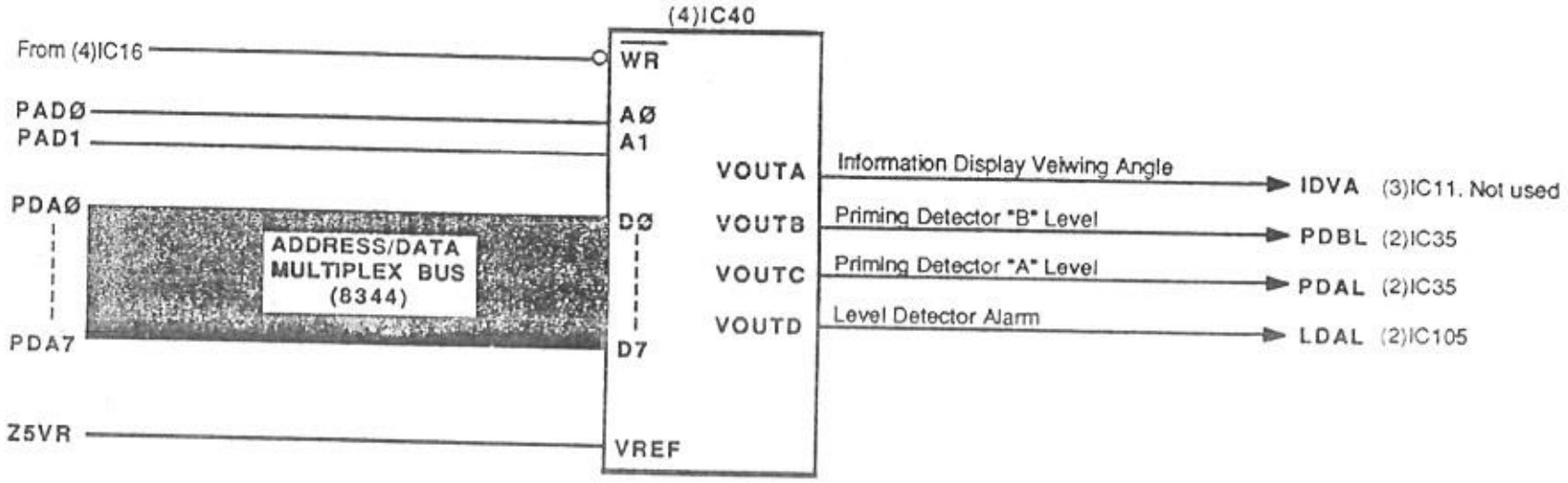

Main board
APRP-N
VPRP-N
BPRP-N
LCUP-N
DAVP-N
Temp main board
Z0VR
Z5VR
Multi-
plexer
IC64
Amplifier
IC32
Sample-
and-
hold
IC31
A/D
converter
IC63
I/O
port
IC42
ADMØ-7
Microcomputer
(80188)
IC5,9,10,22,23,
24,41,57,73,
84,103,414
Low byte
High byte
INTØ
Reference
voltage
generator
IC33

)perator's communications



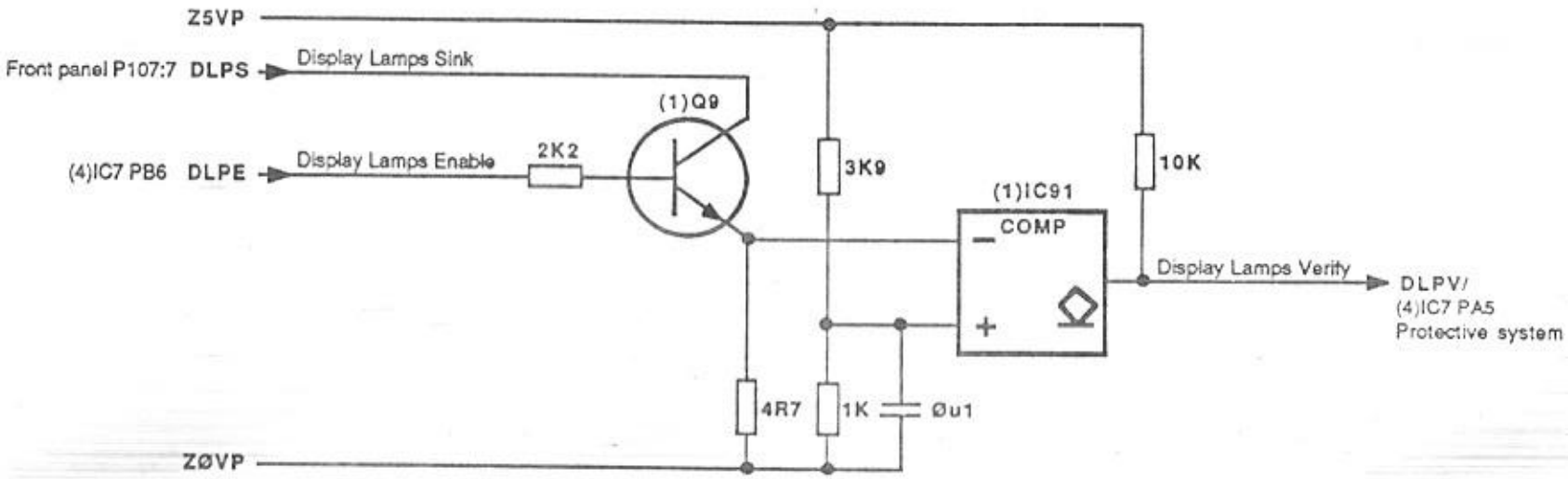
AK 100 BM D/A converter(protective system)

B.O. 02. 1988



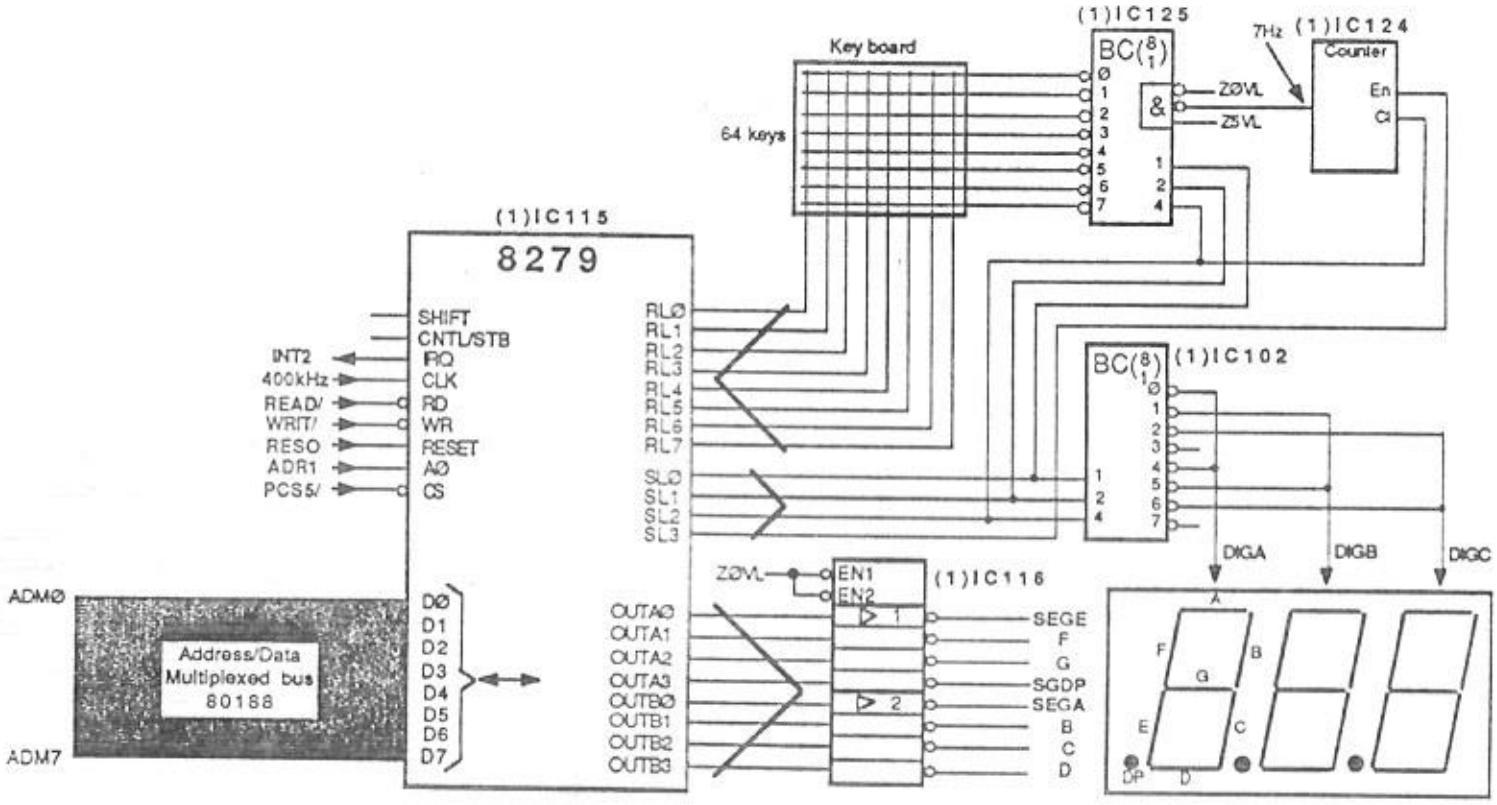
AK 100 BM Display Control circuit

B.O. 02. 1988



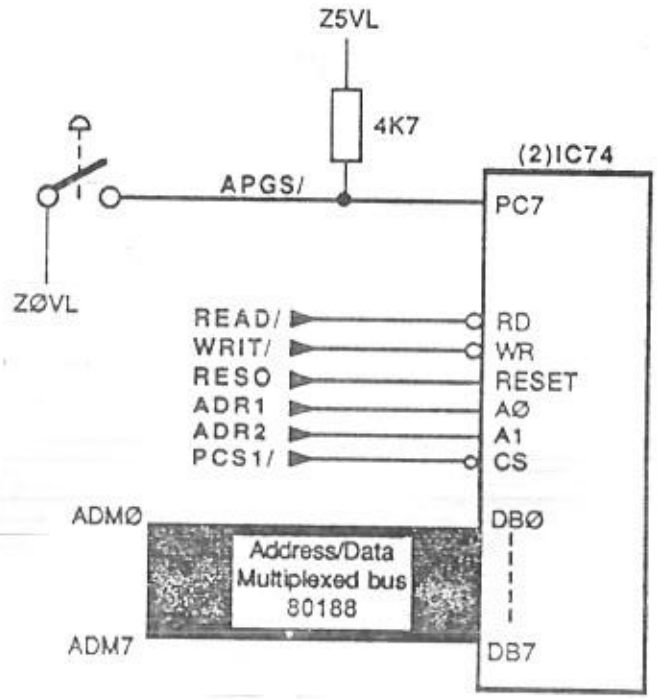
AK 100 BM Keyboard-controller

B.O. 02. 1988



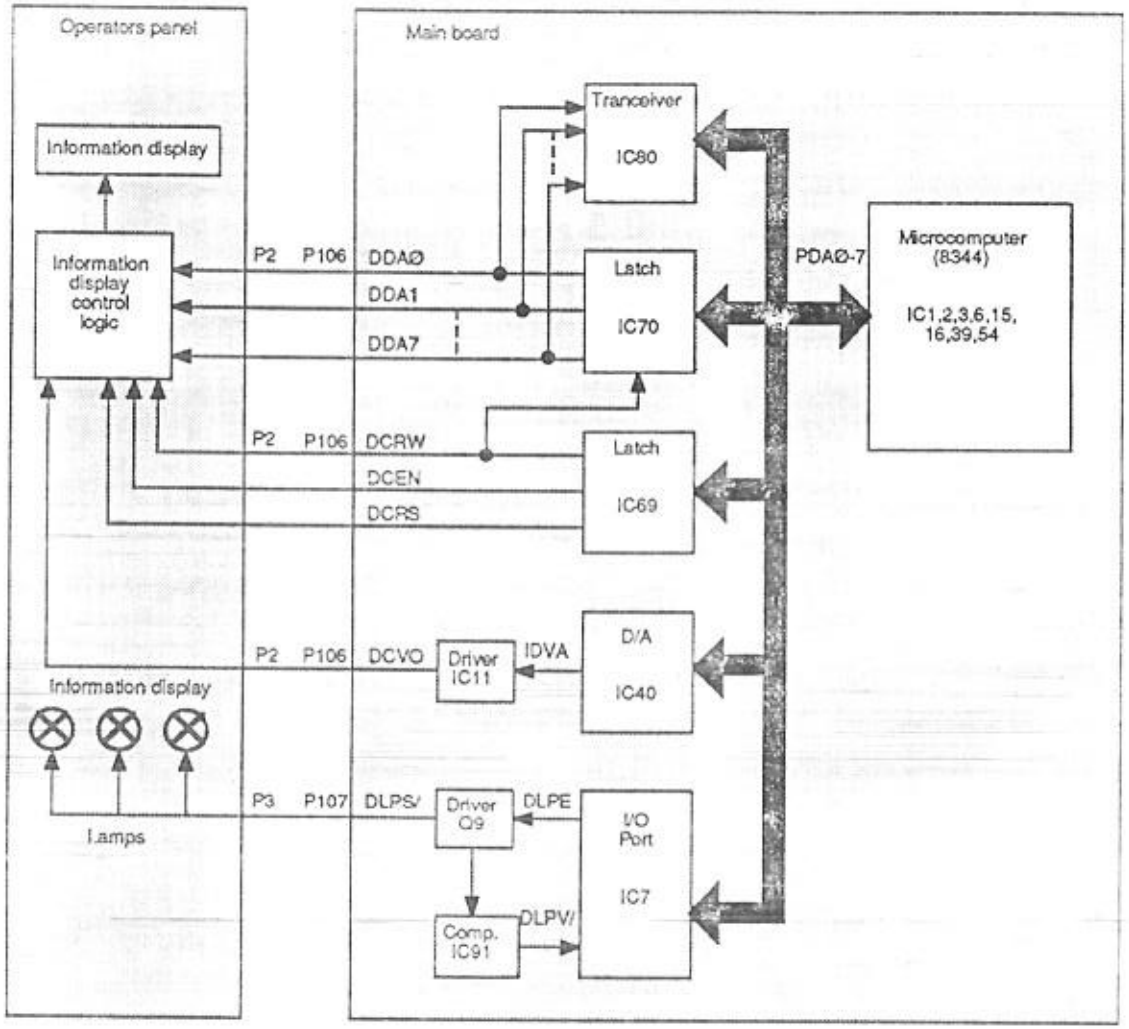
AK 100 BM Arte.ial Pressure Guard

B.O. 02. 1988



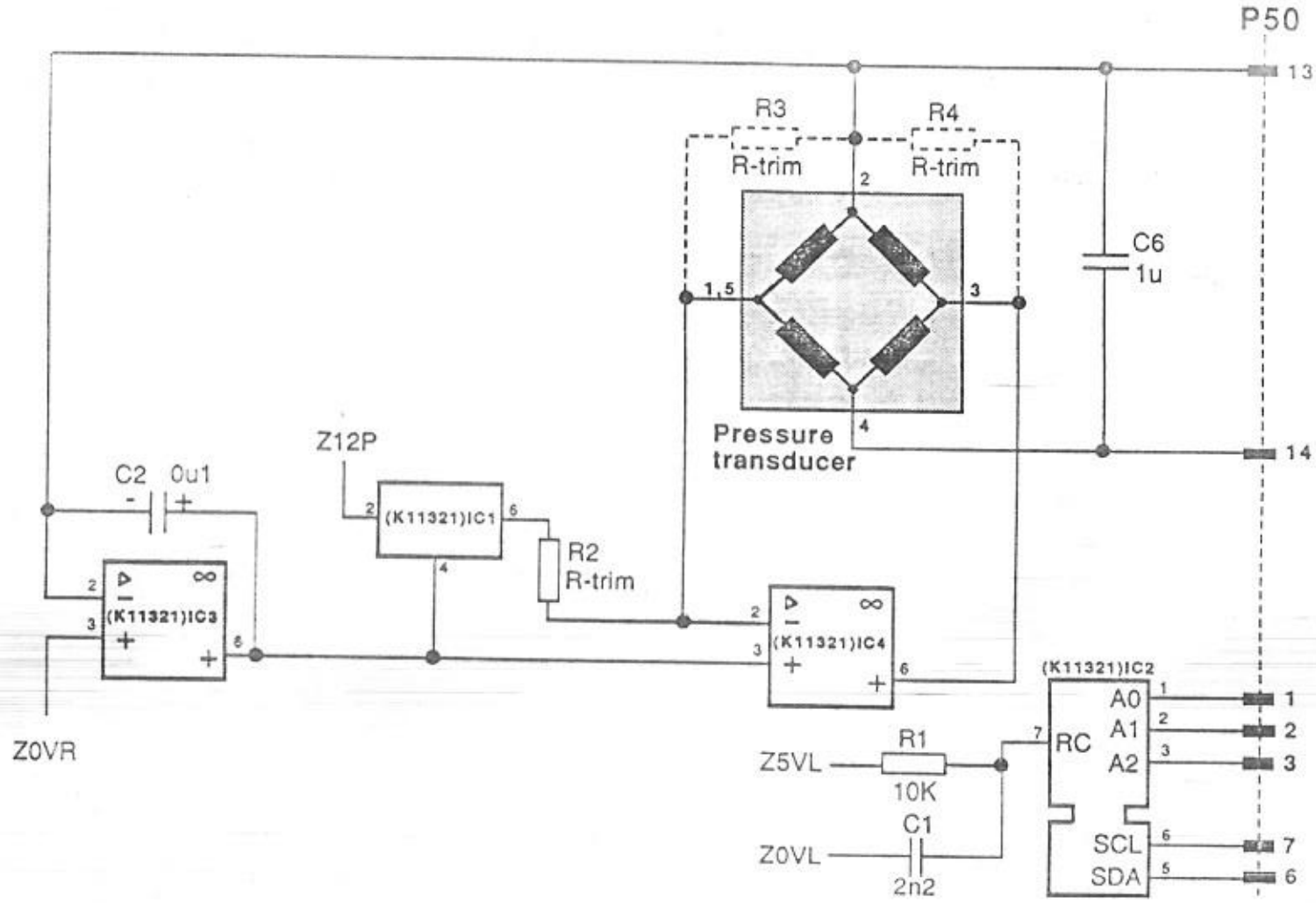
formation Display Control

05. 1988

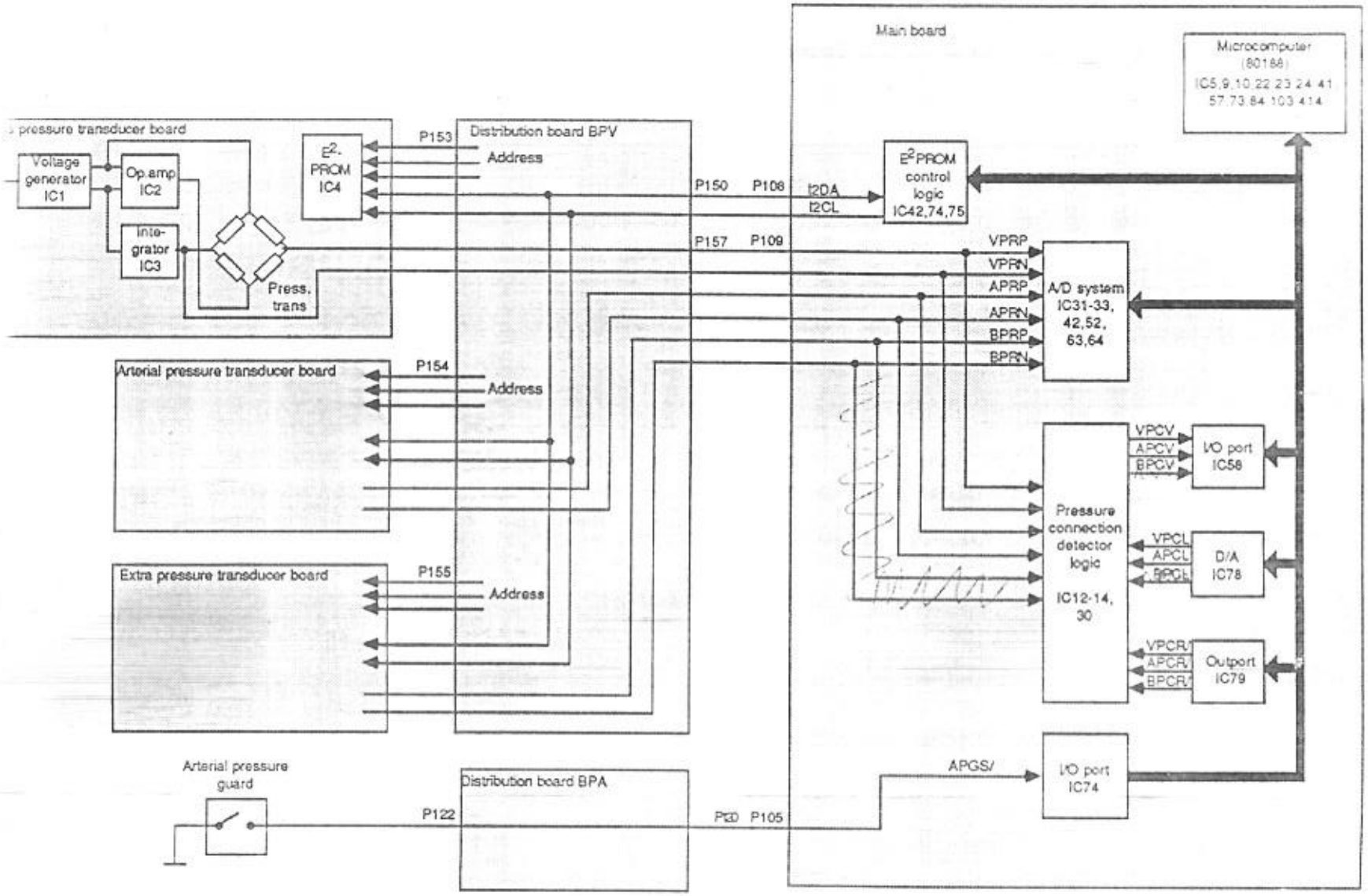


AK 100 BM/FM Pressure transducer board

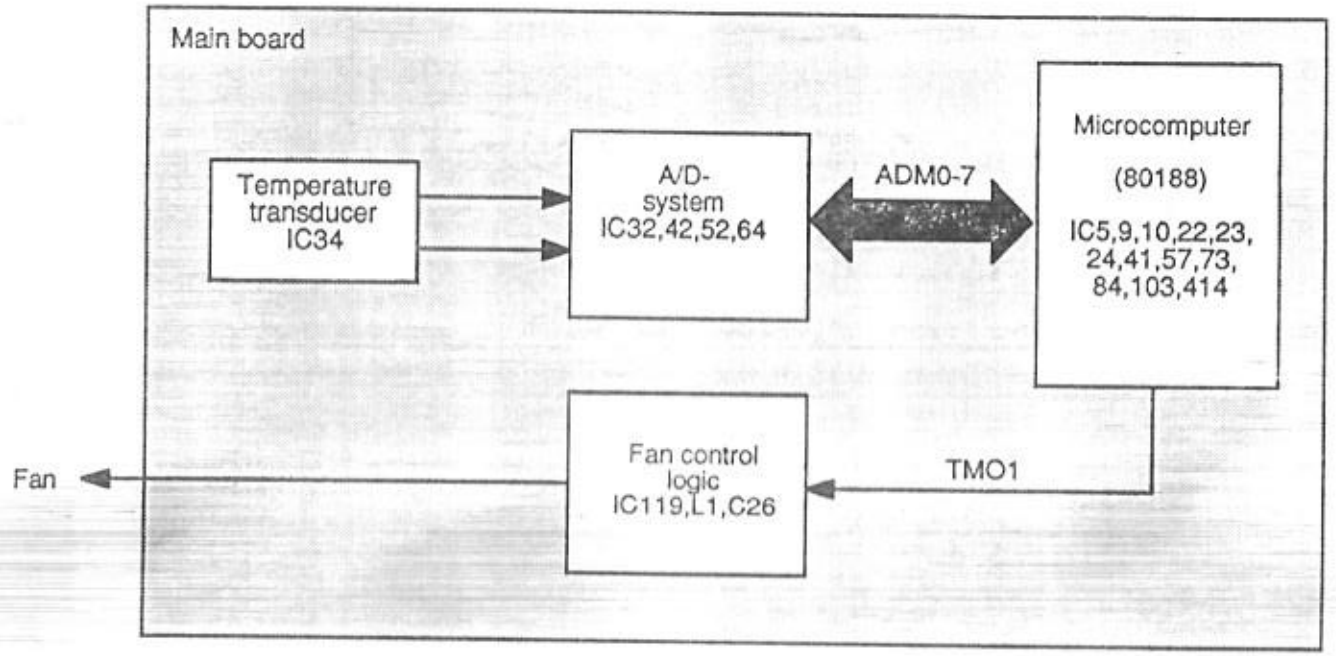
B.O. 02. 1988



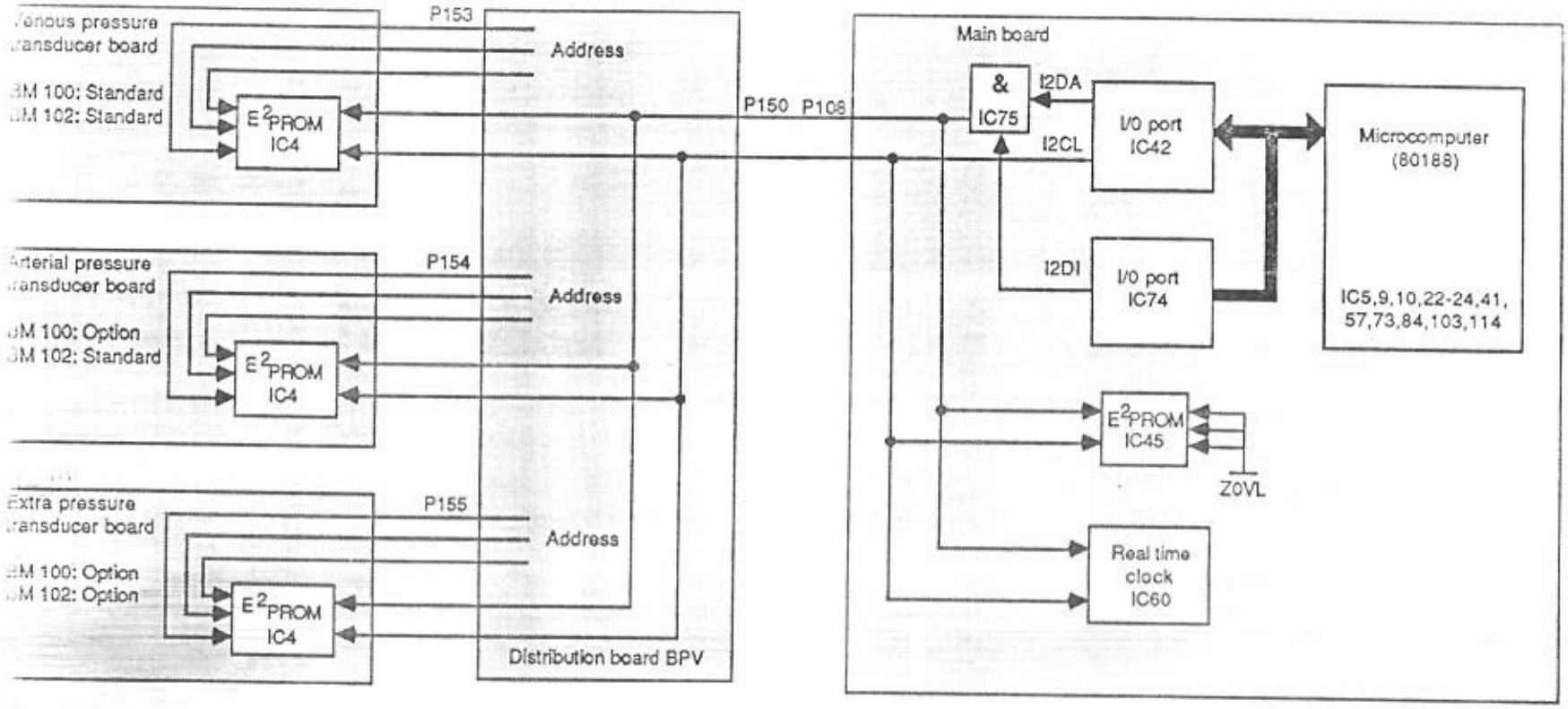
ressure monitoring



Main board temperature monitoring and regulation

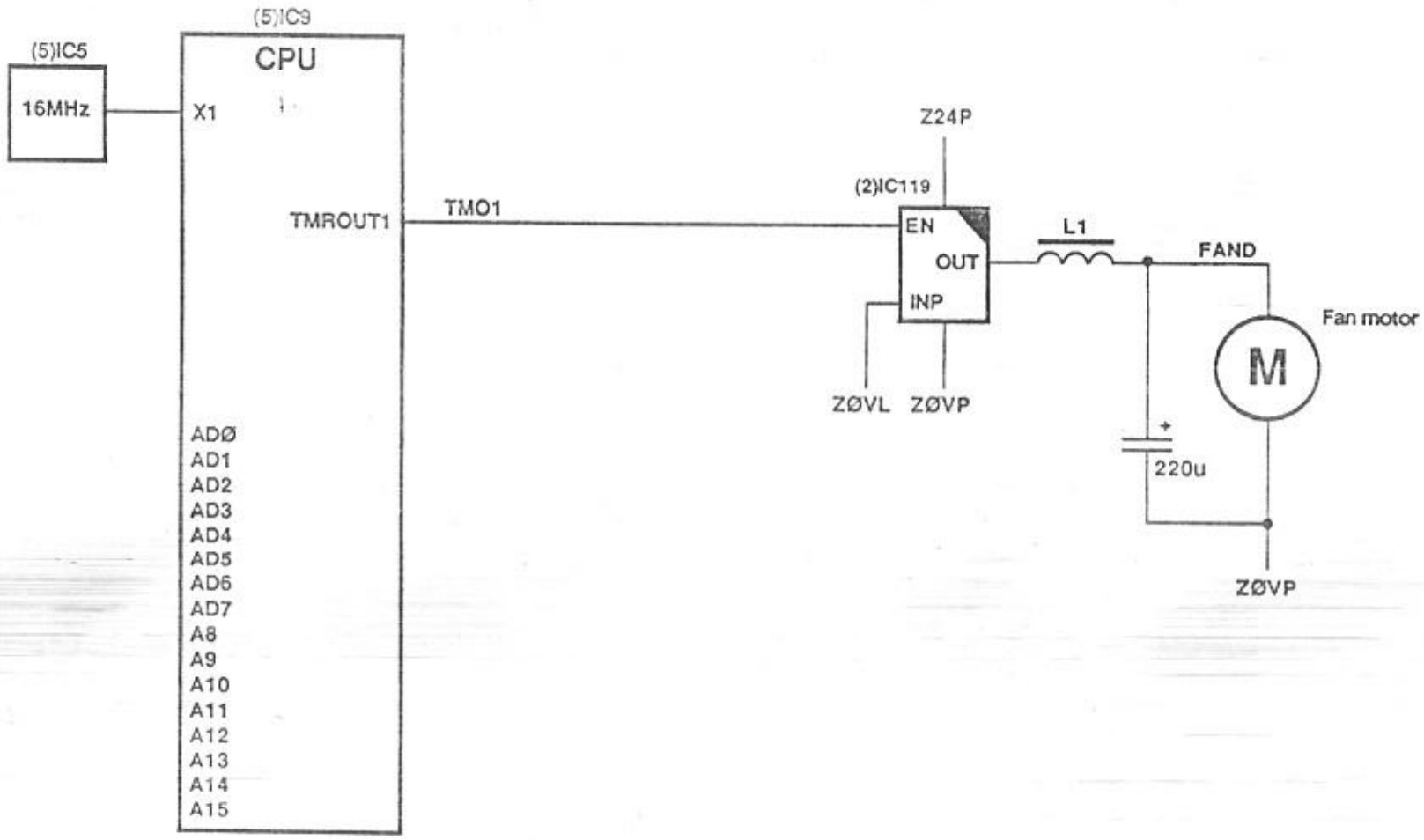


^{2} PROM control (Control system)



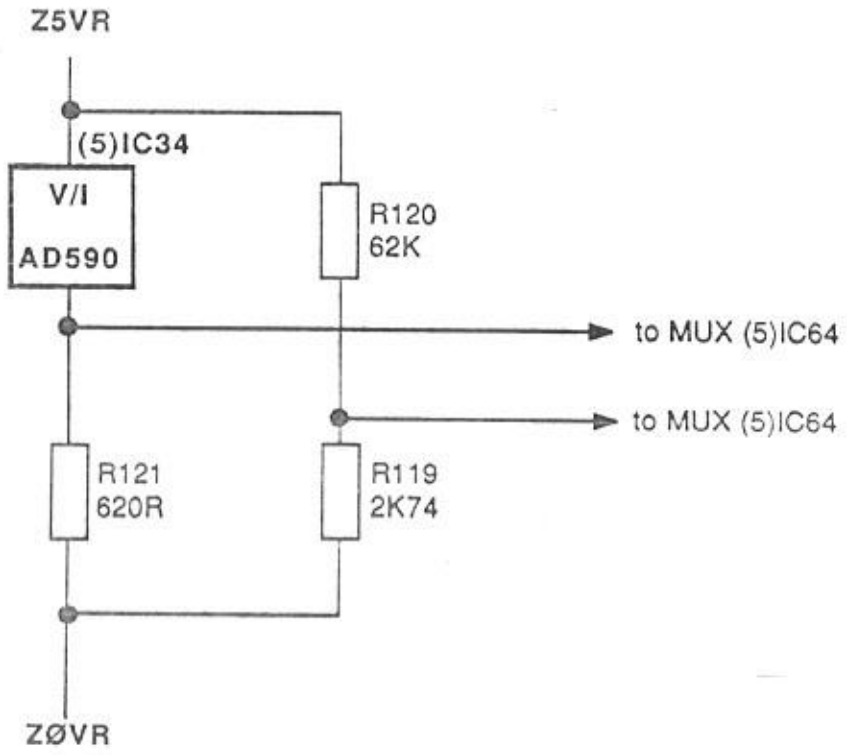
X 100 BM Fan motor circuit

. 06. 1988



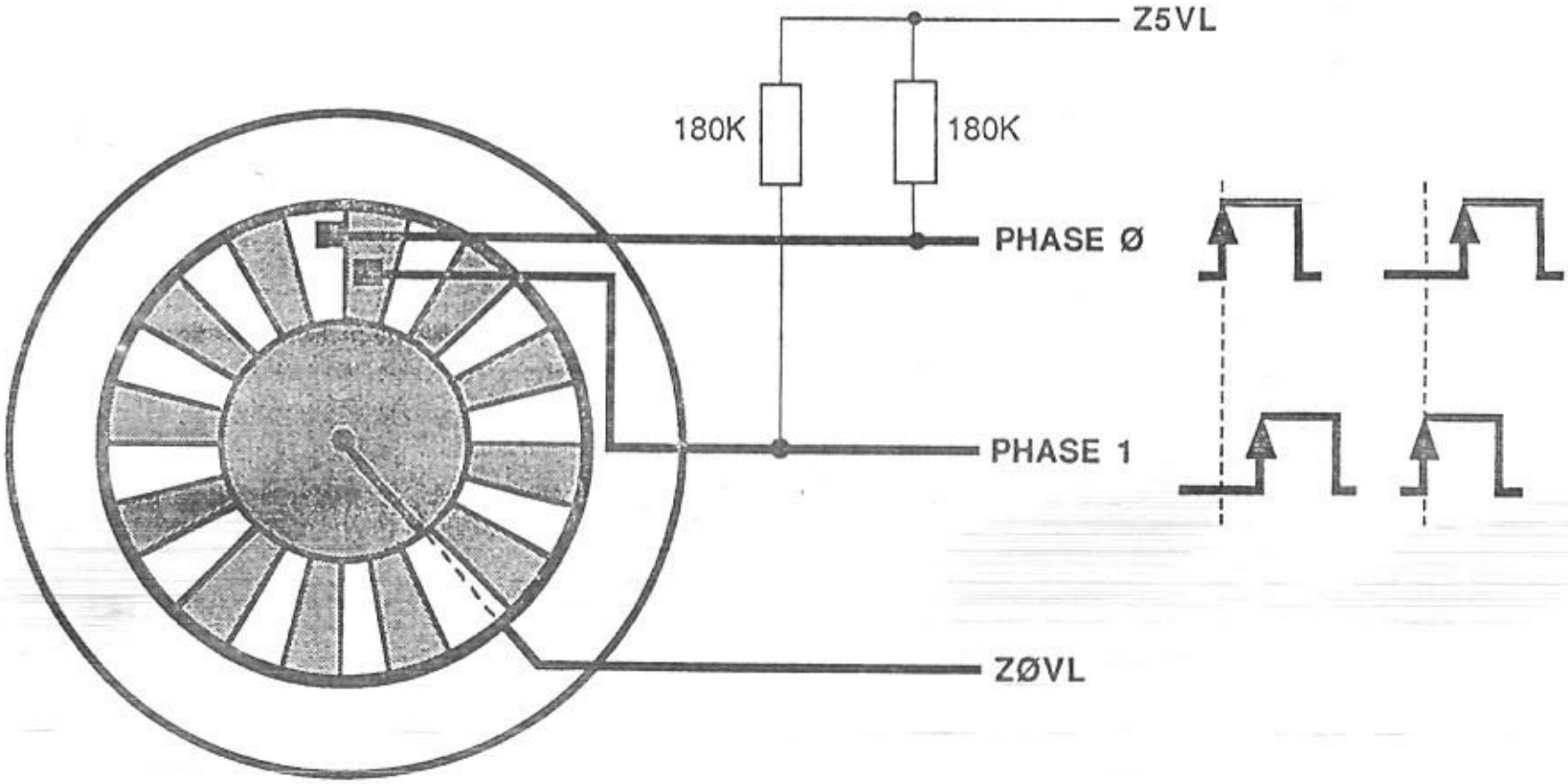
AK 100 BM Main board temperature circuit

B.O. 02. 1988



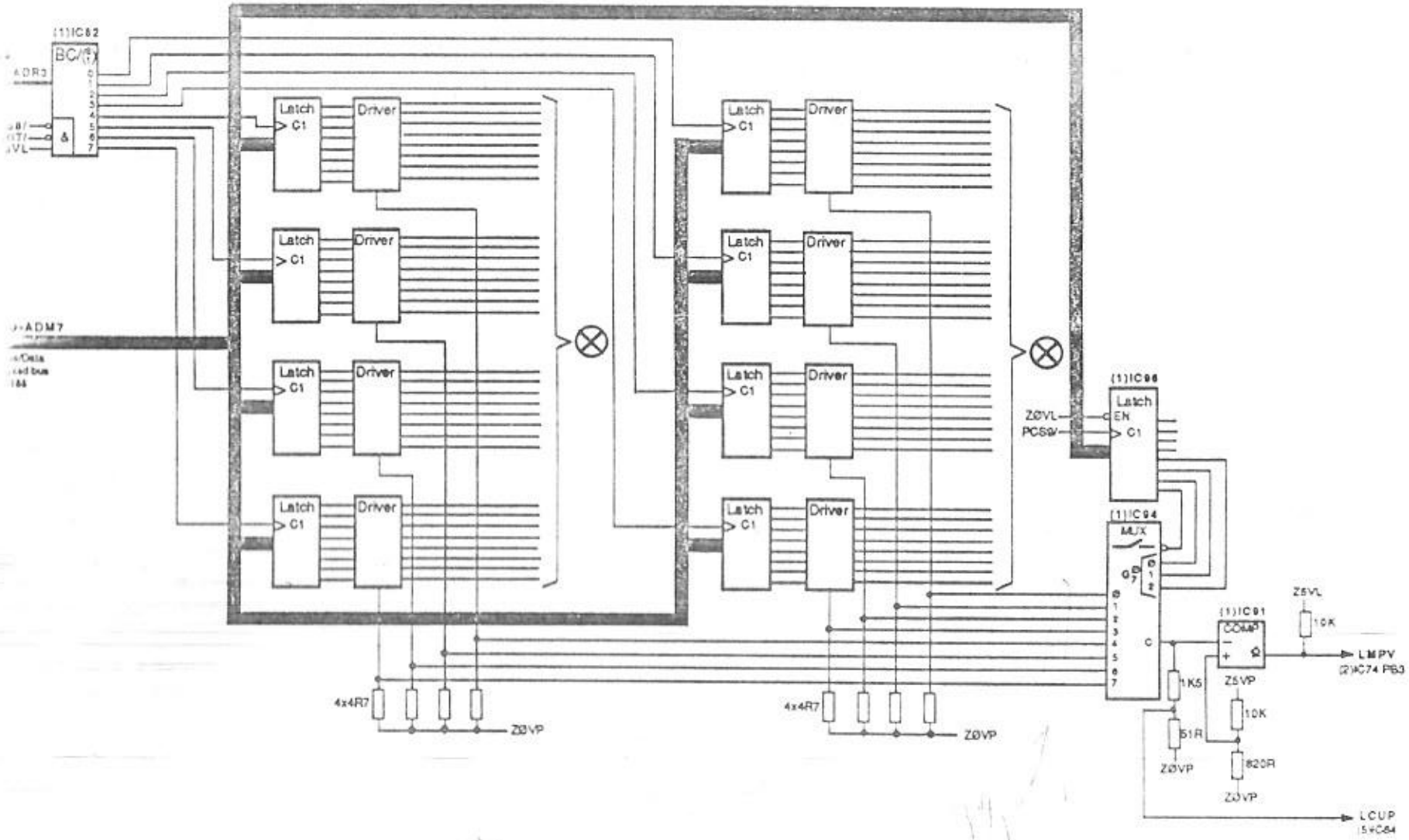
AK 100 BM Potentiometer circuit

B.O. 02. 1988



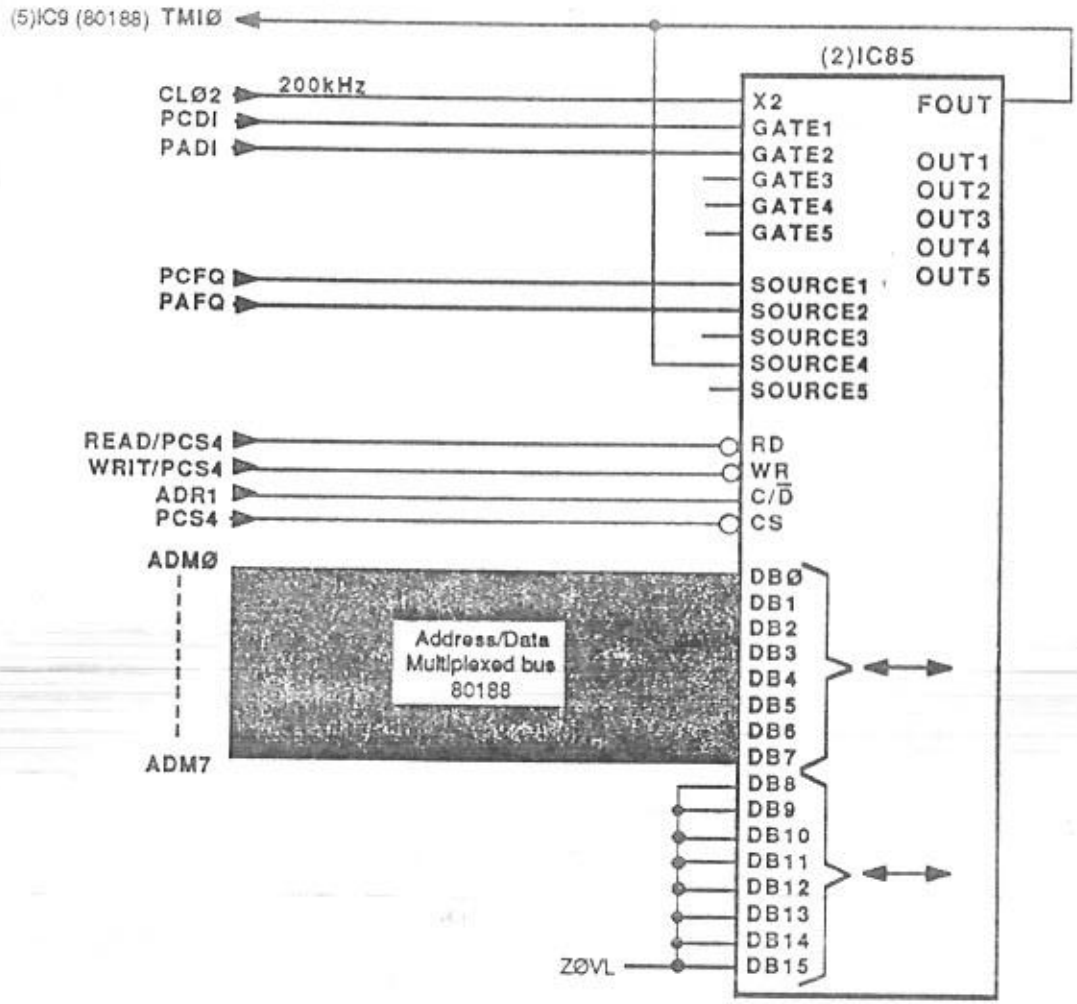
K 100 BM Lamp drive and control circuit

. 02. 1988



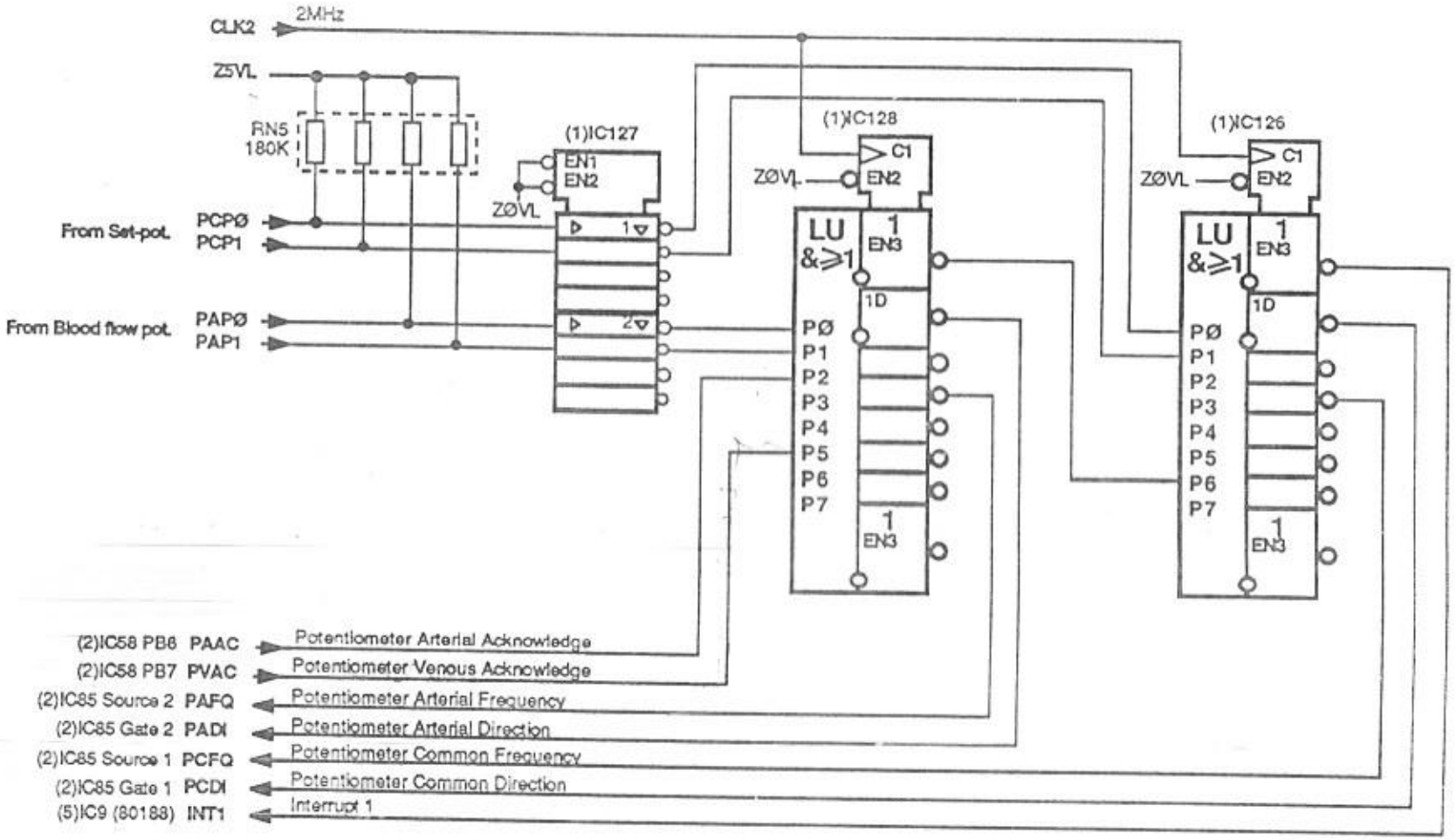
AK 100 BM Pot..ntio..ieter circuit

B.O. 02. 1988



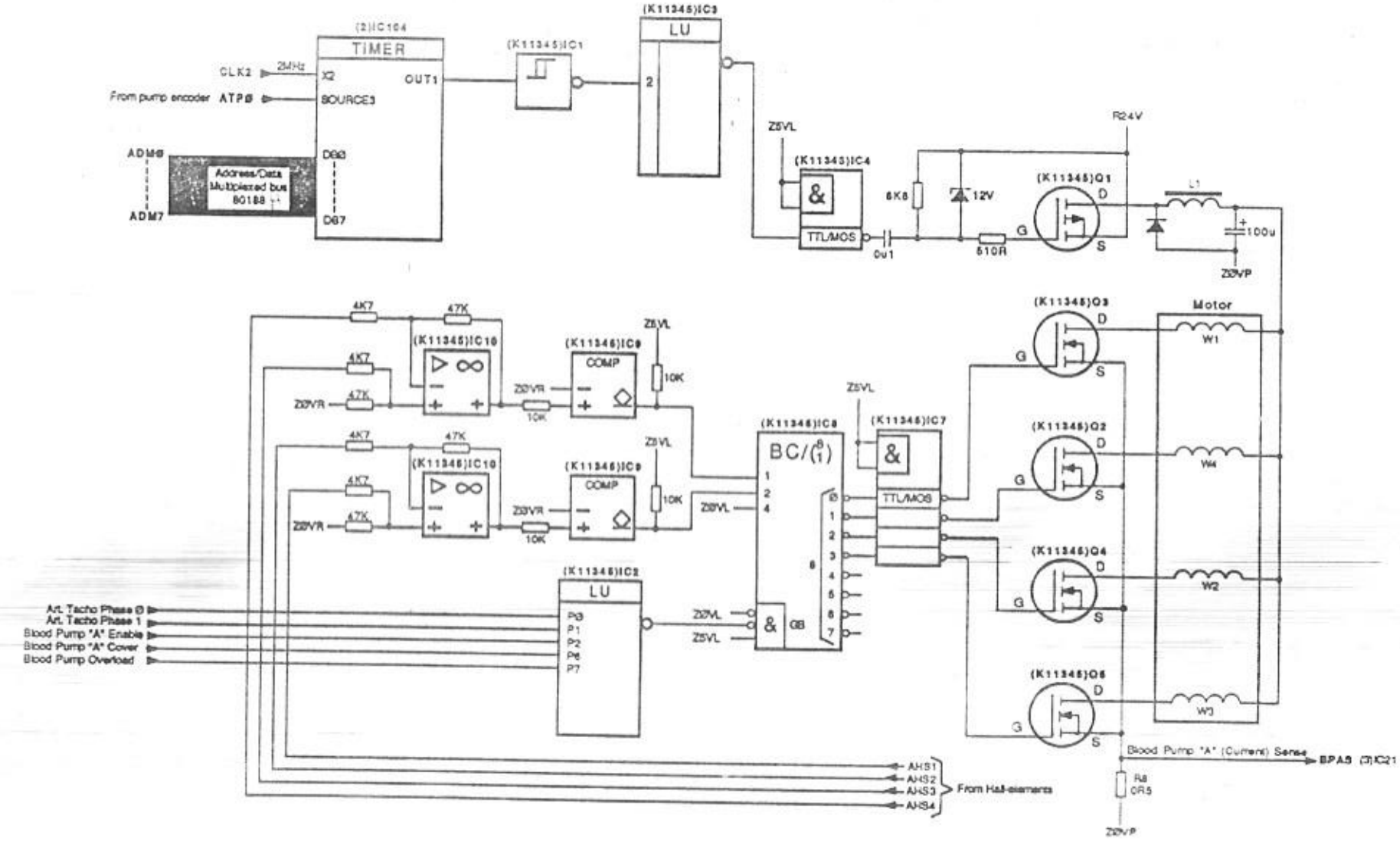
AK 100 BM Potentiometer circuit

B.O. 02. 1988

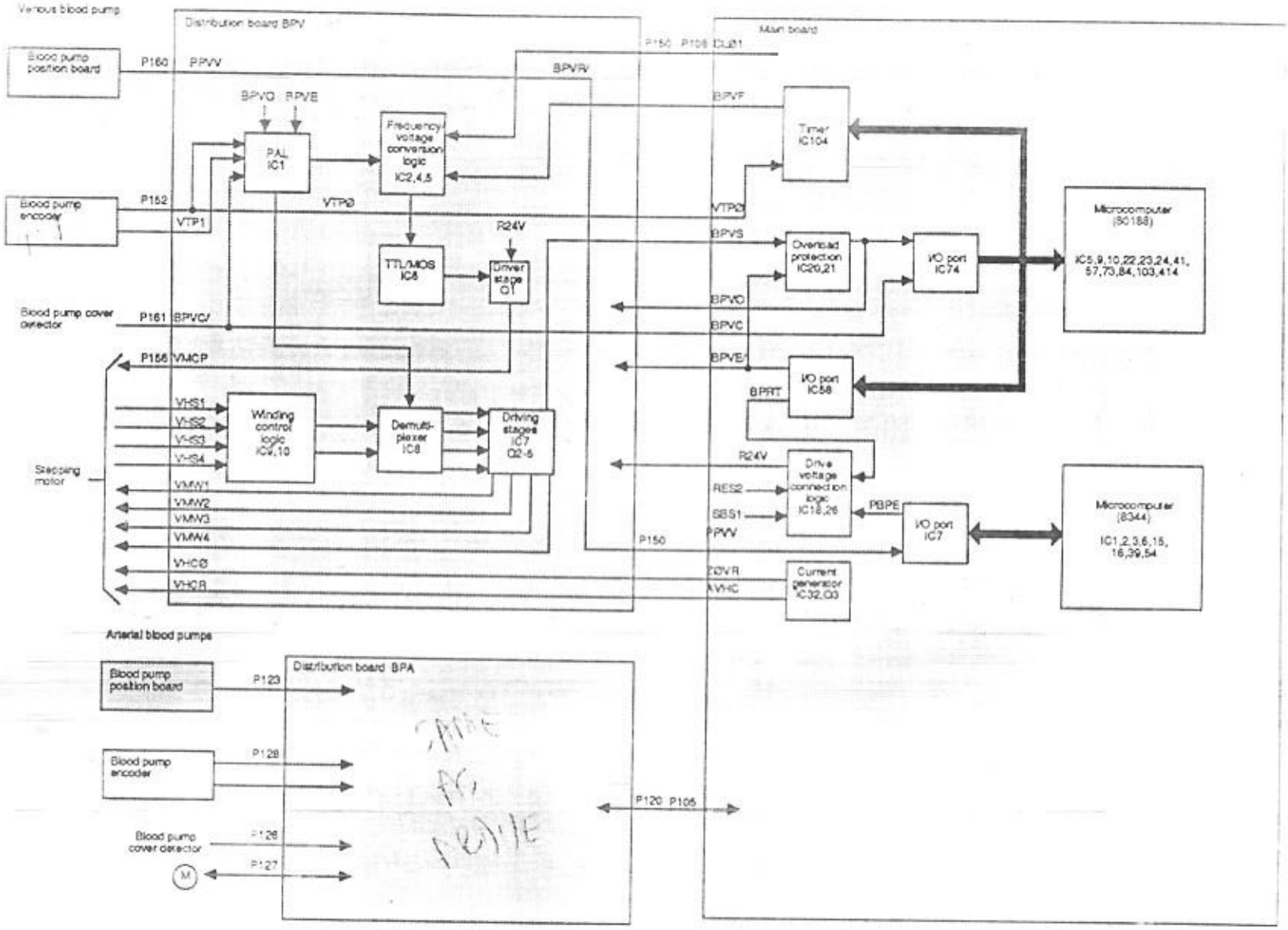


AK 100 BM Arterial blood pump circuit

.O. 02. 1988

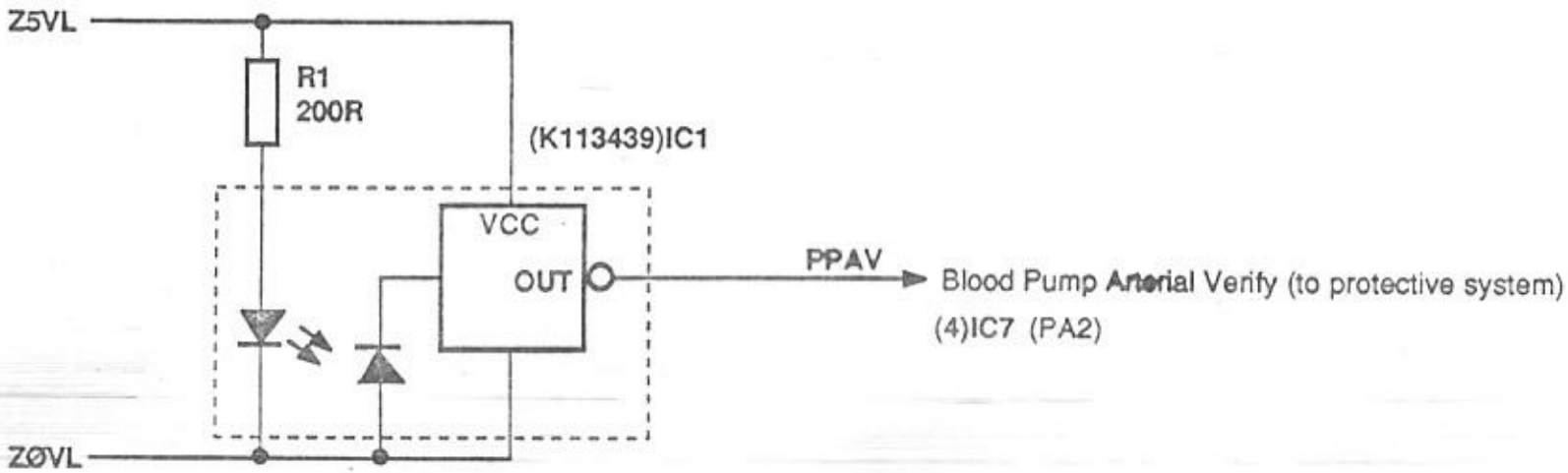


Blood flow regulation



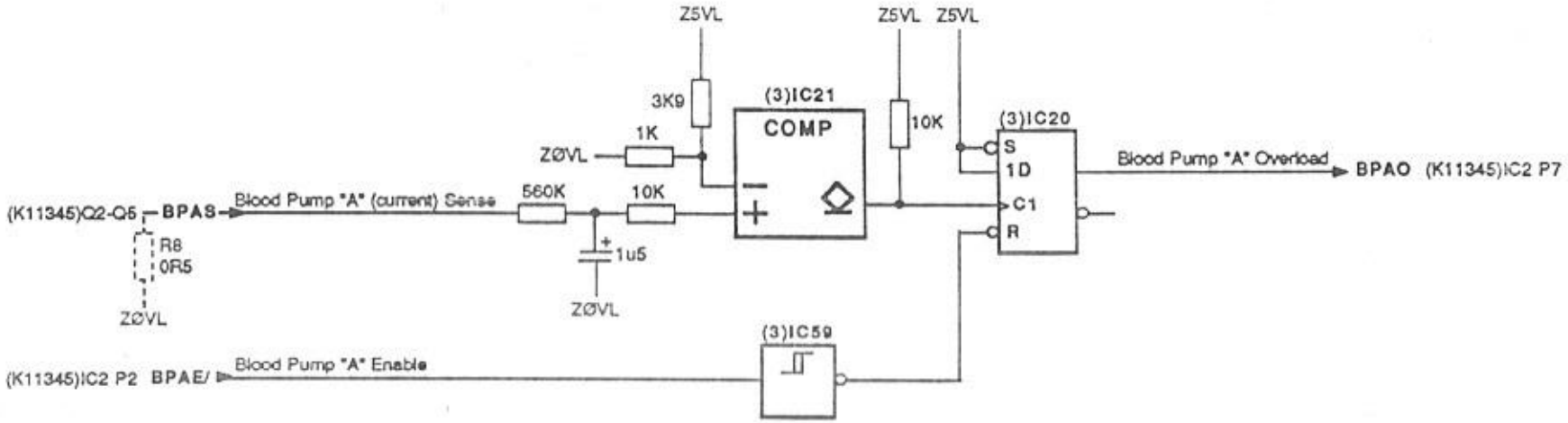
100 BM Arterial Blood Pump Position Board

07. 1988



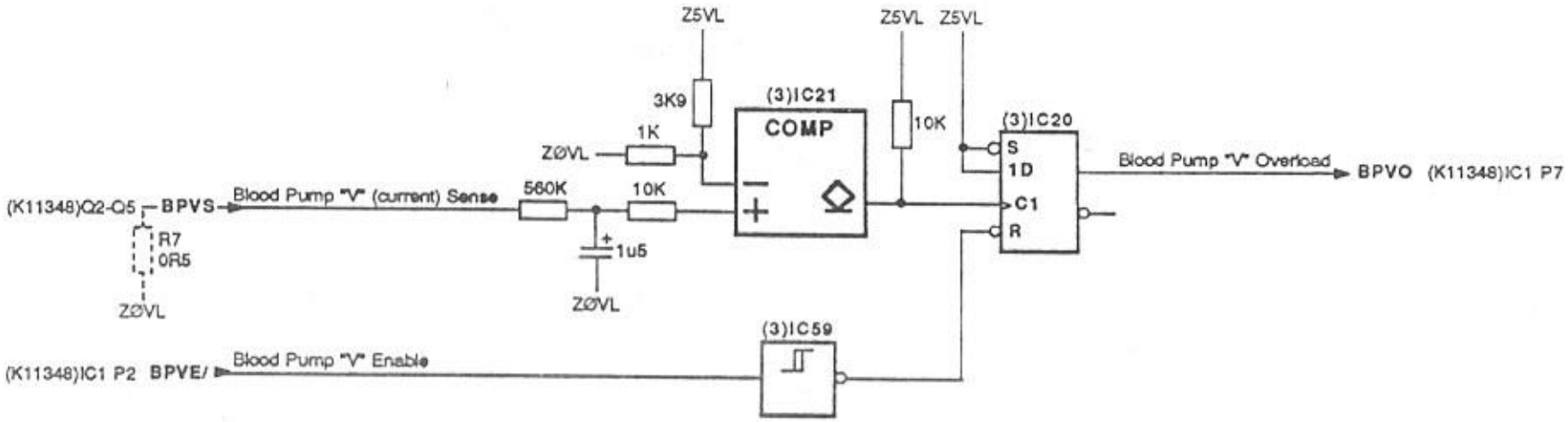
AK 100 BM Arterial Blood pump overload circuit

B.O. 02. 1988



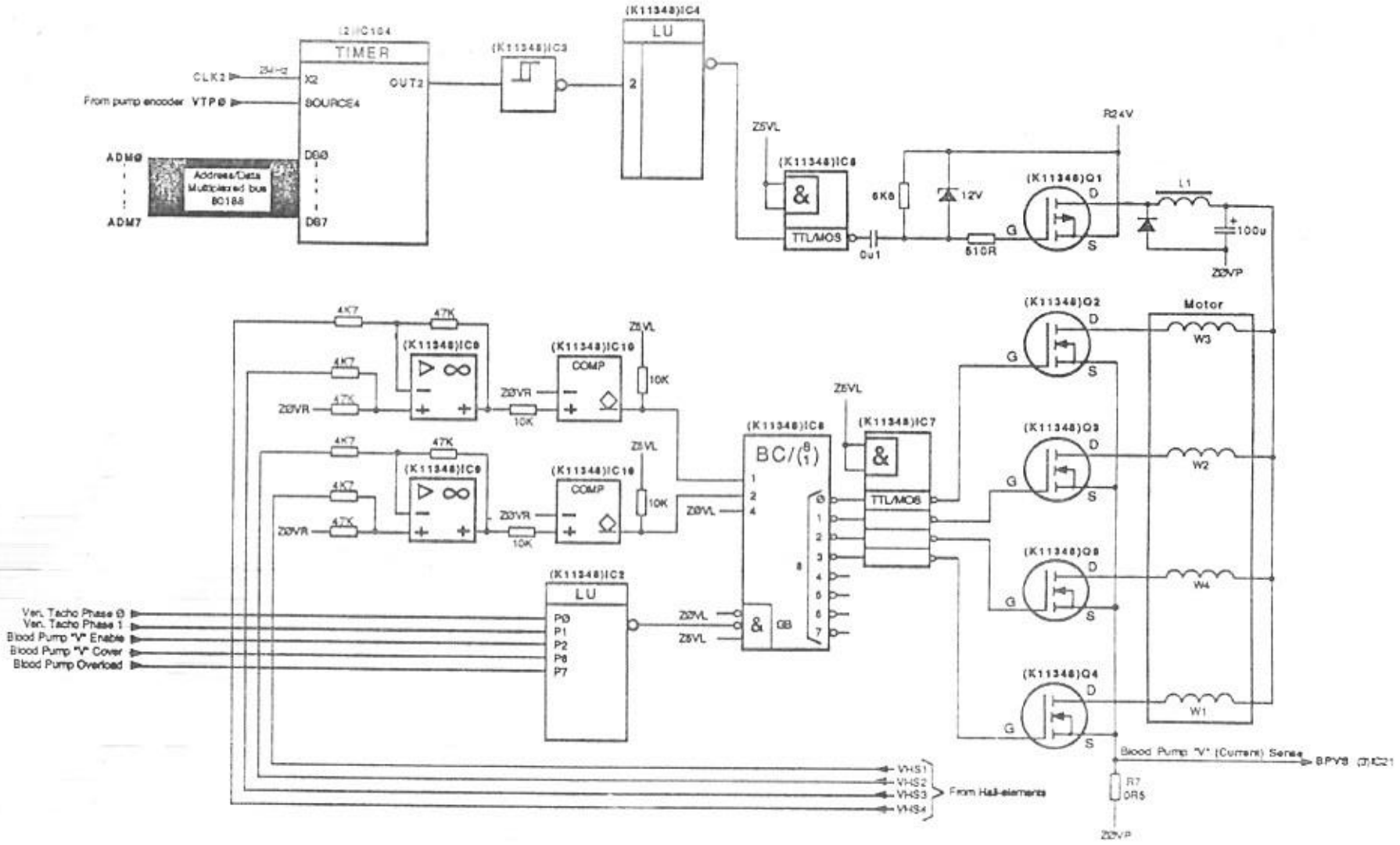
AK 100 BM Venous Blood pump overload circuit

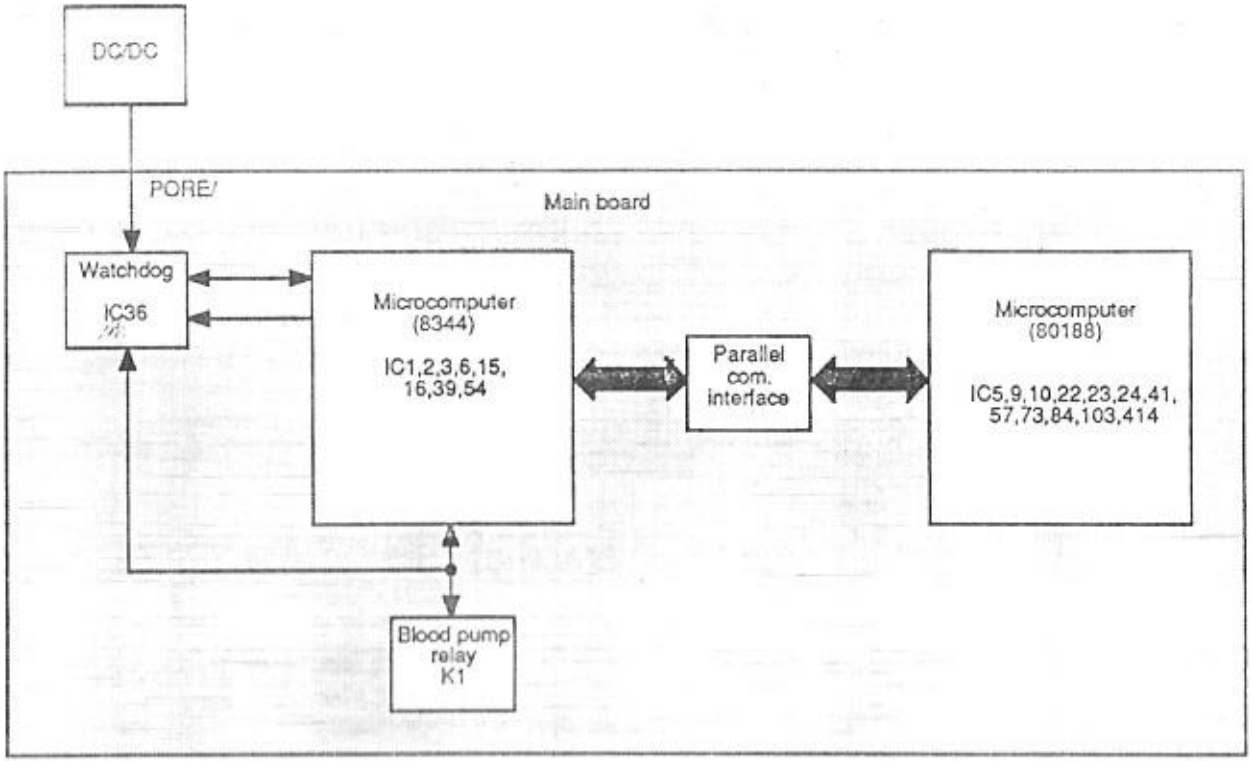
.O. 02. 1988



AK 100 BM Venous blood pump circuit

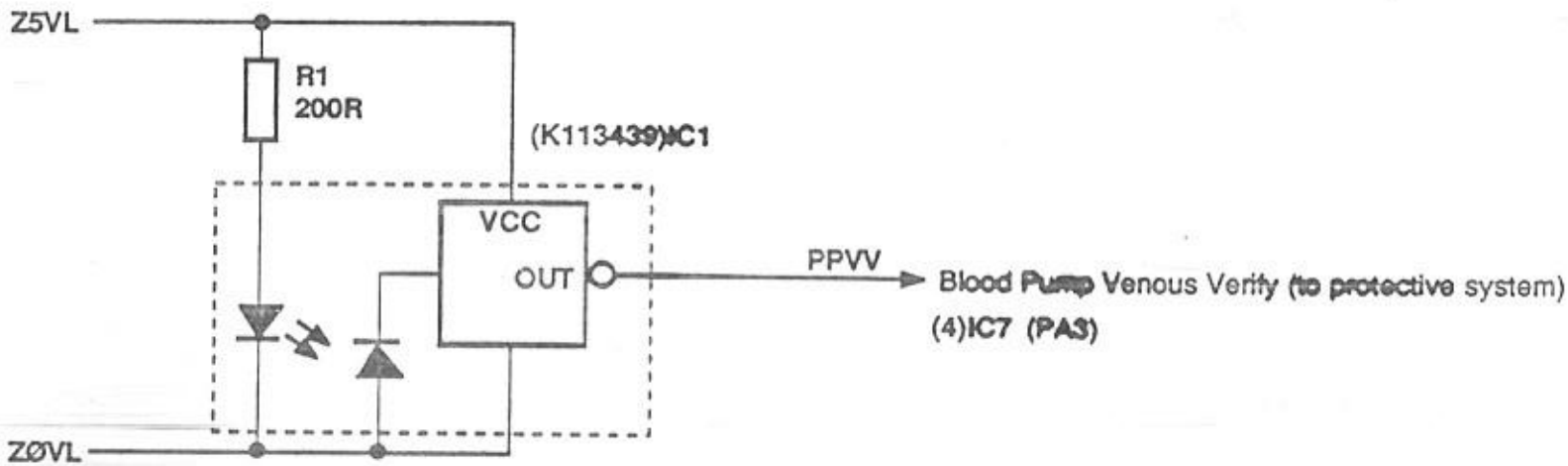
B.O. 02. 1988



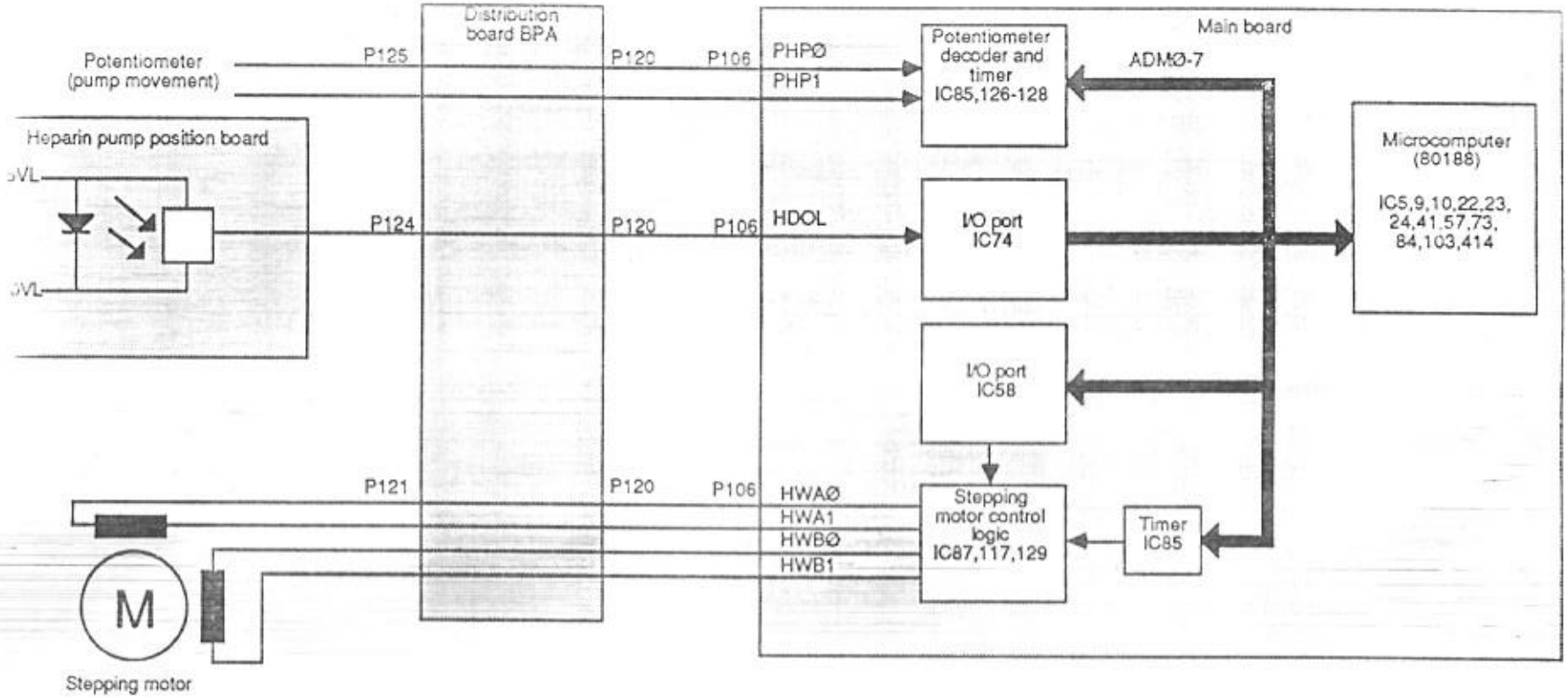

DC/DC
PORE/
Main board
Watchdog
IC36
Microcomputer
(8344)
IC1,2,3,6,15,
16,39,54
Parallel
com.
interface
Microcomputer
(80188)
IC5,9,10,22,23,24,41,
57,73,84,103,414
Blood pump
relay
K1

K 100 BM Venous Blood Pump Position Board

. 07. 1988

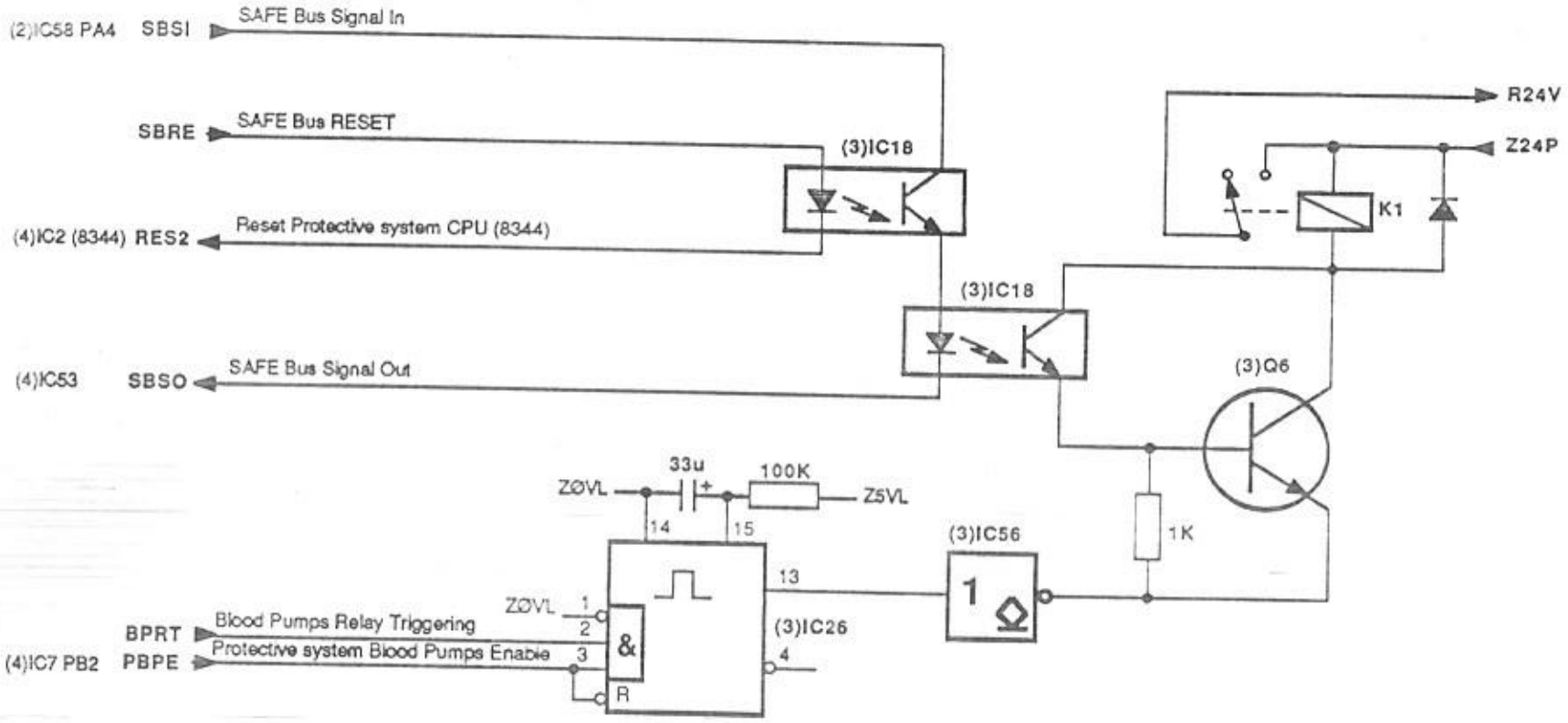


Heparin flow regulation



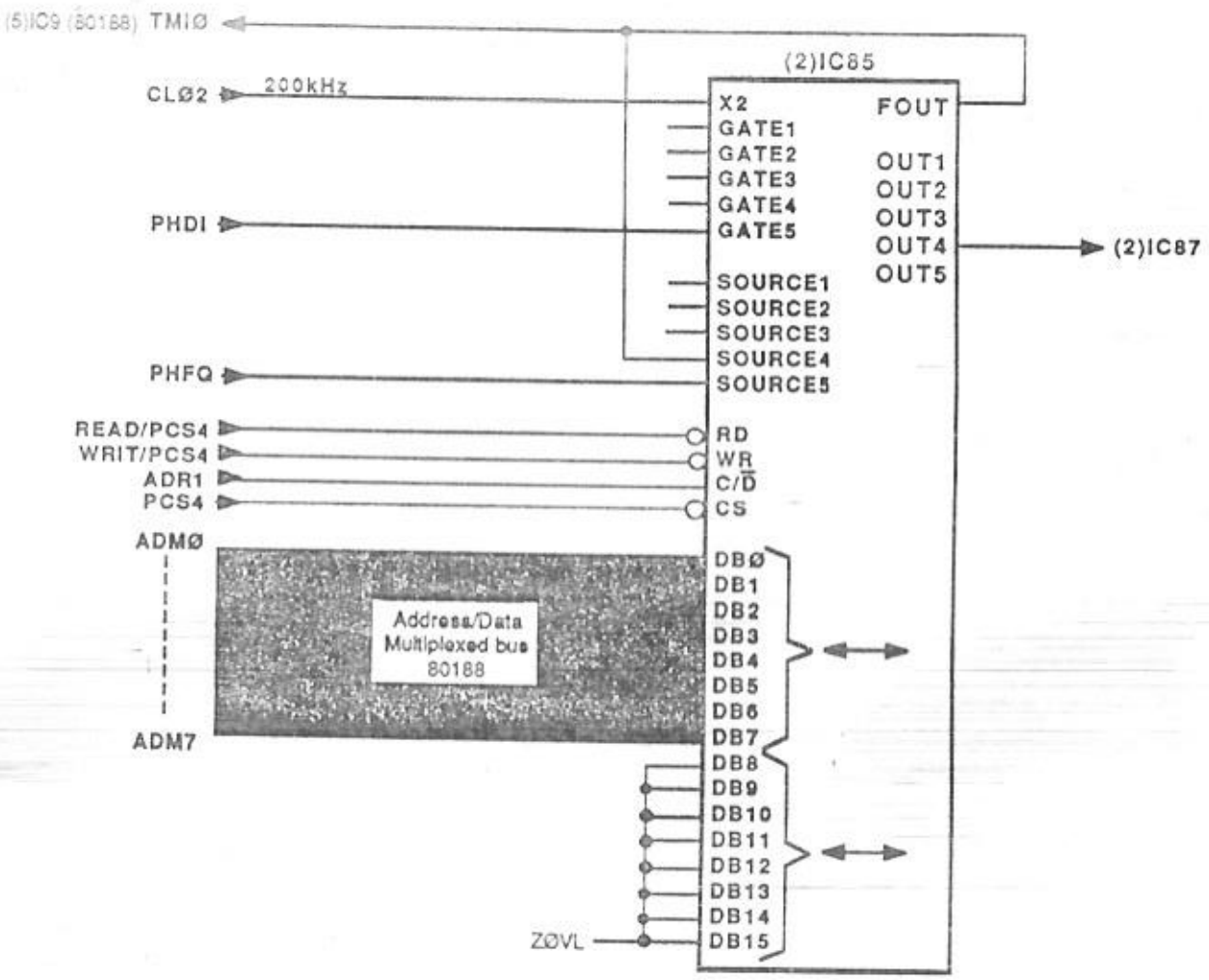
AK 100 BM Blood Pumps Safety Relay Circuit

B.O. 02. 1988



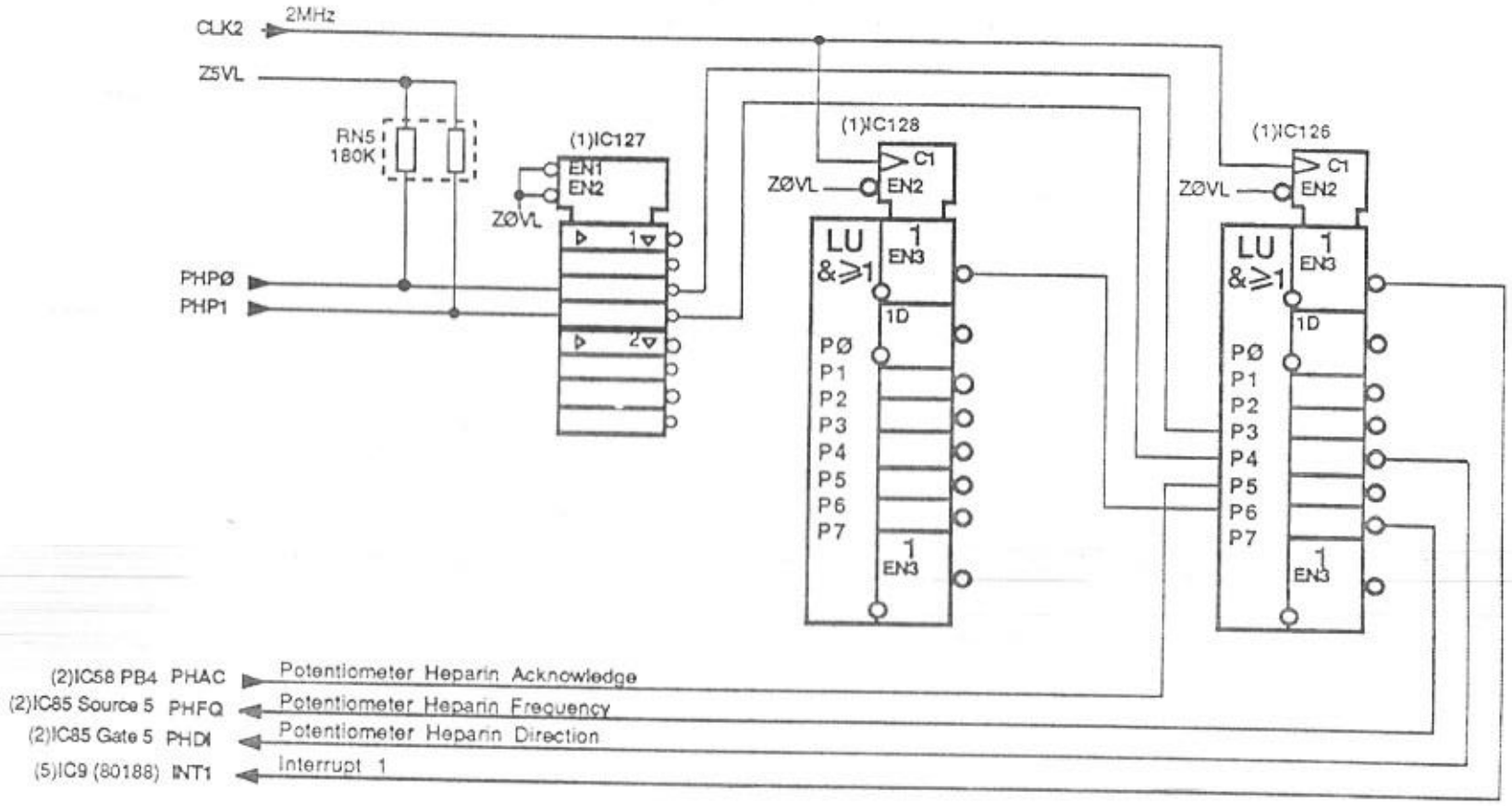
AK 100 BM Heparin position potentiometer circuit

B.O. 02. 1988

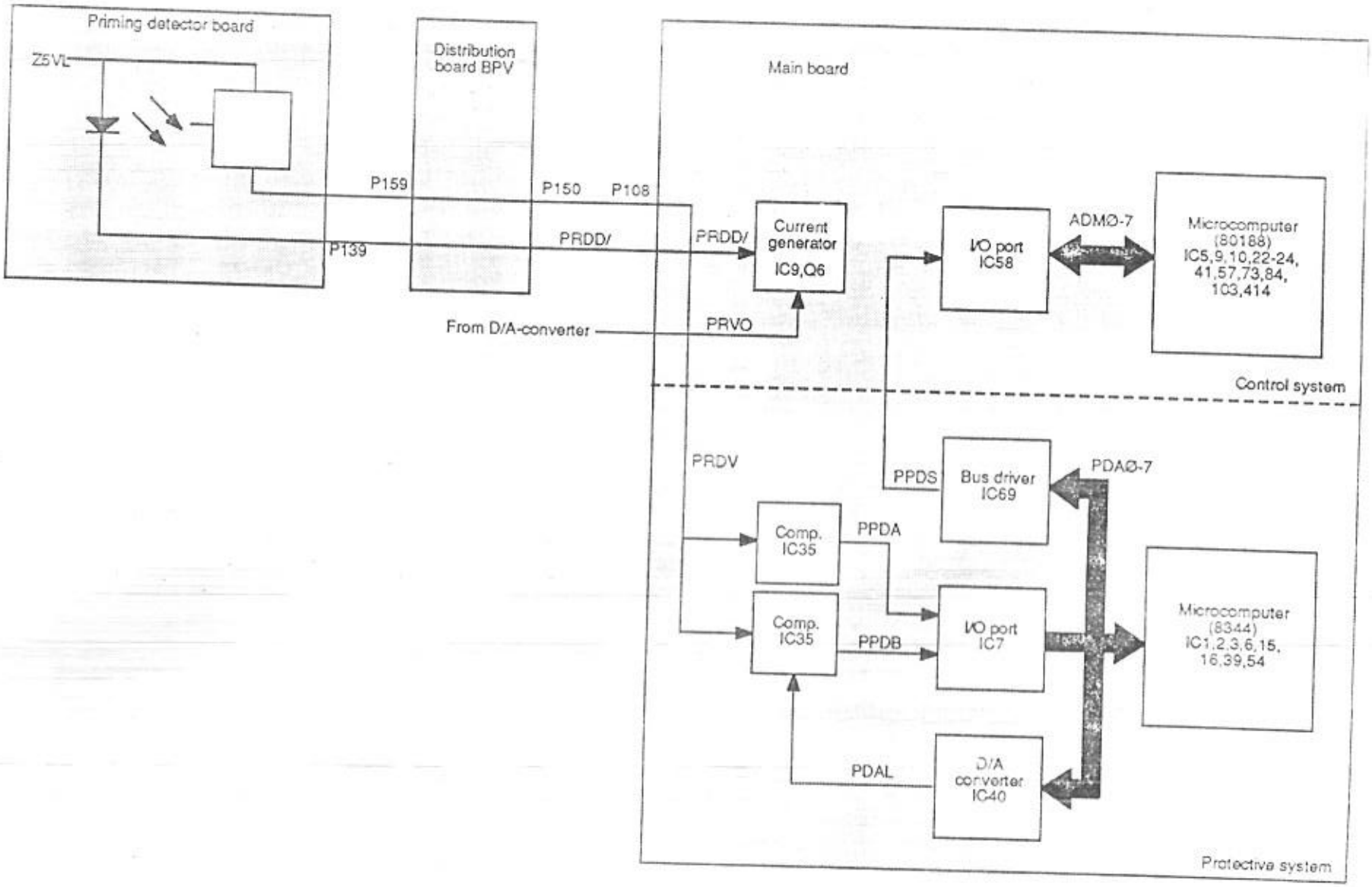


AK 100 BM Heparin position potentiometer circuit

B.O. 02. 1988

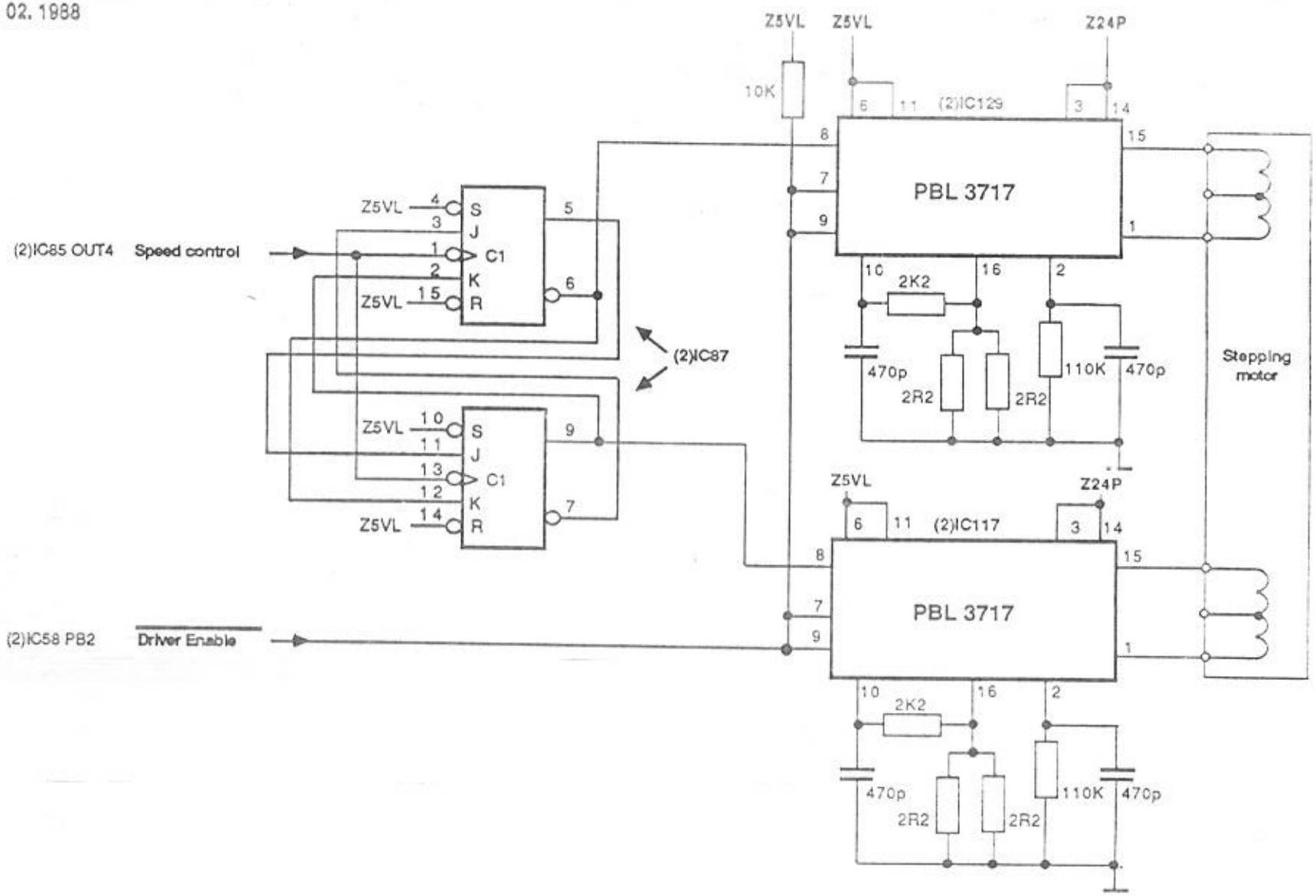


Priming detector

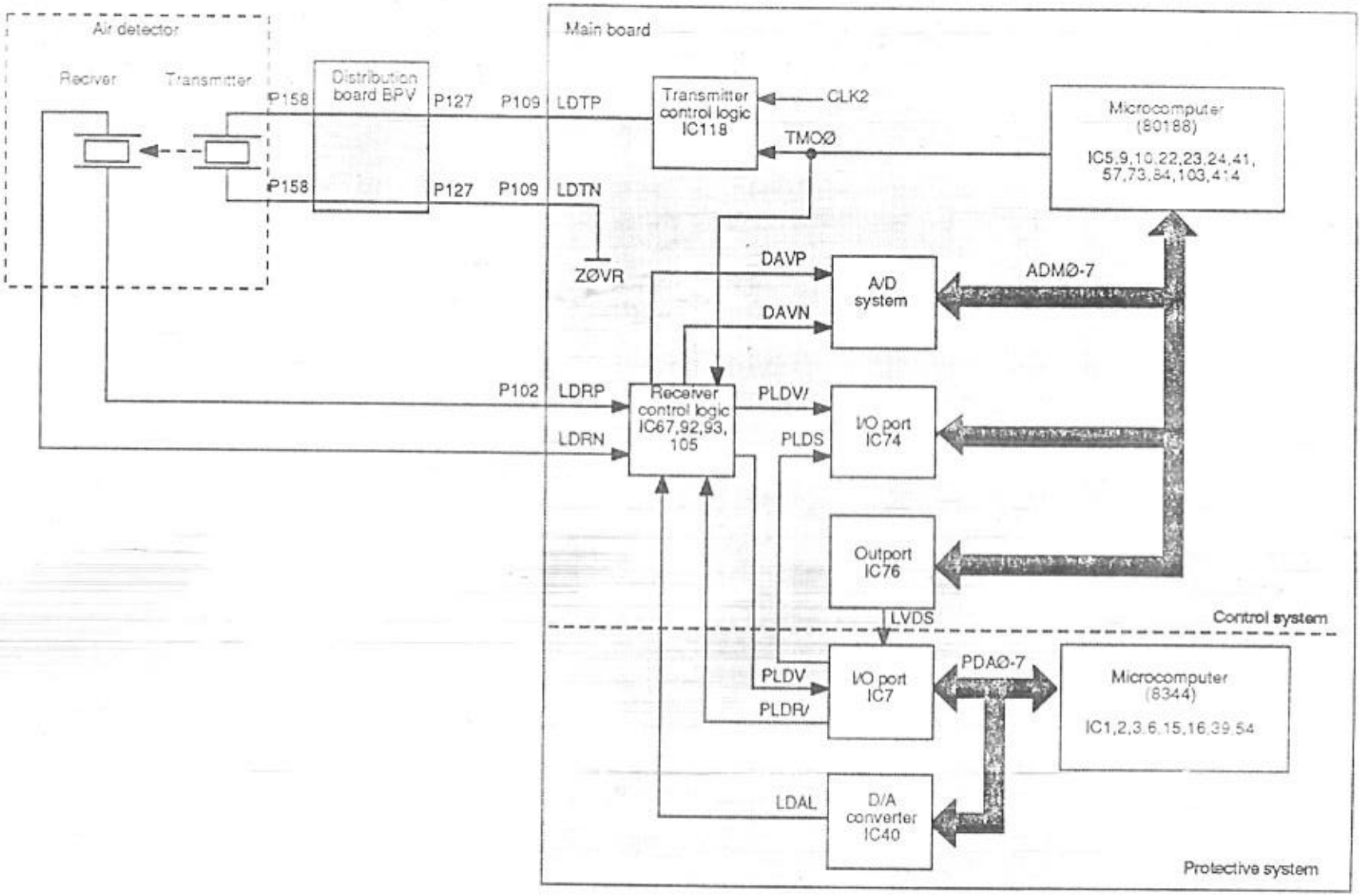


AK 100 BM Heparin pump motor controller

B.O. 02. 1988

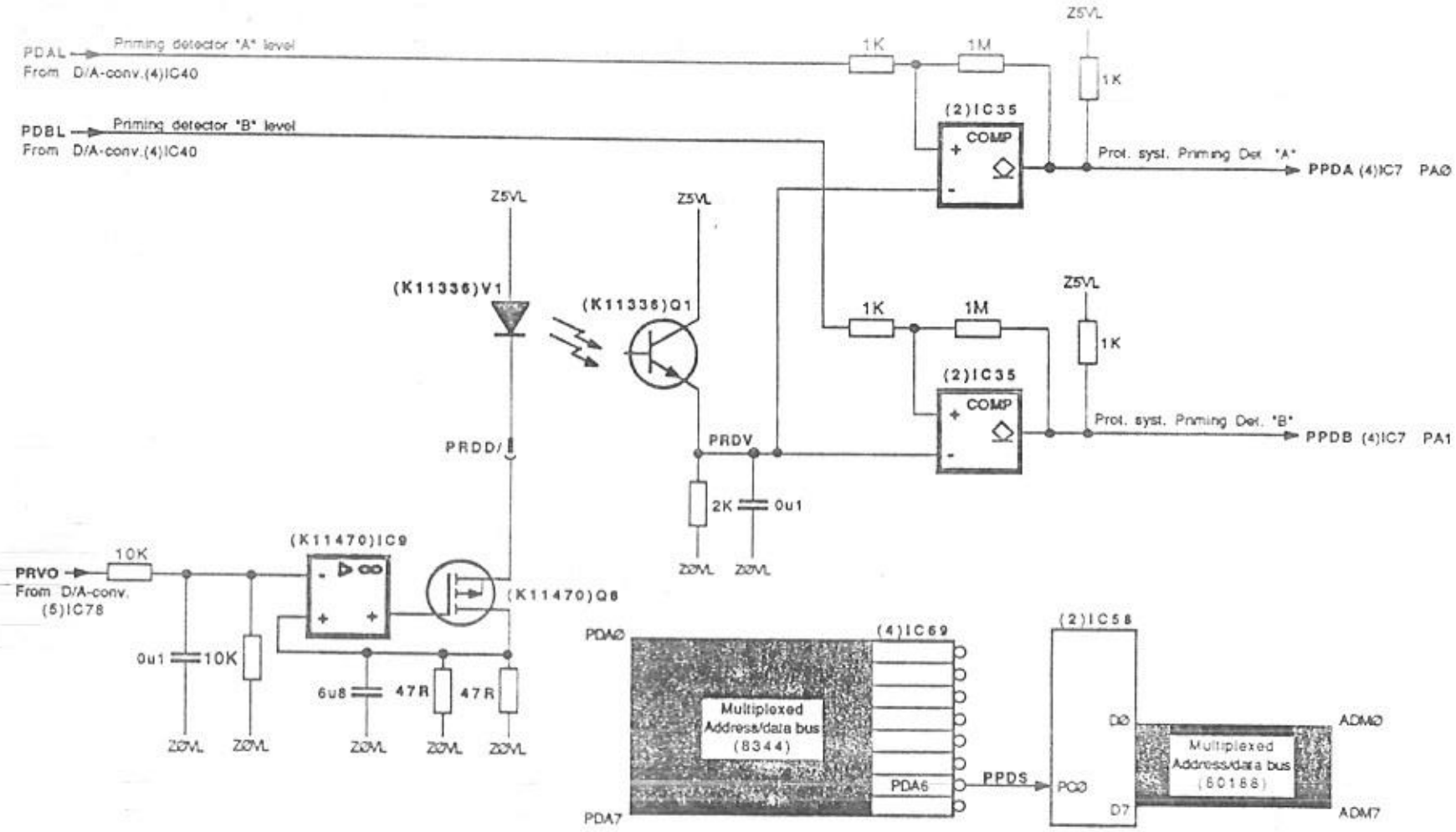


Air detection

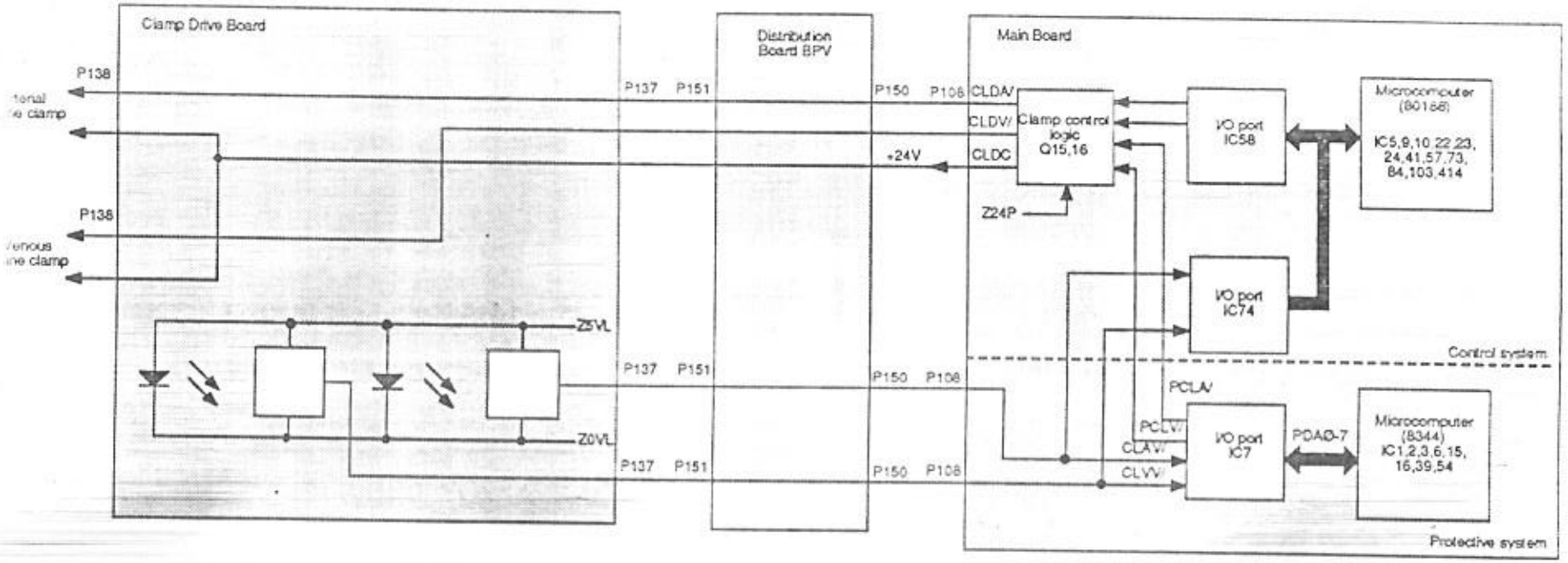


AK 100 BM Prin..ng detector circuit

B.O. 04. 1988

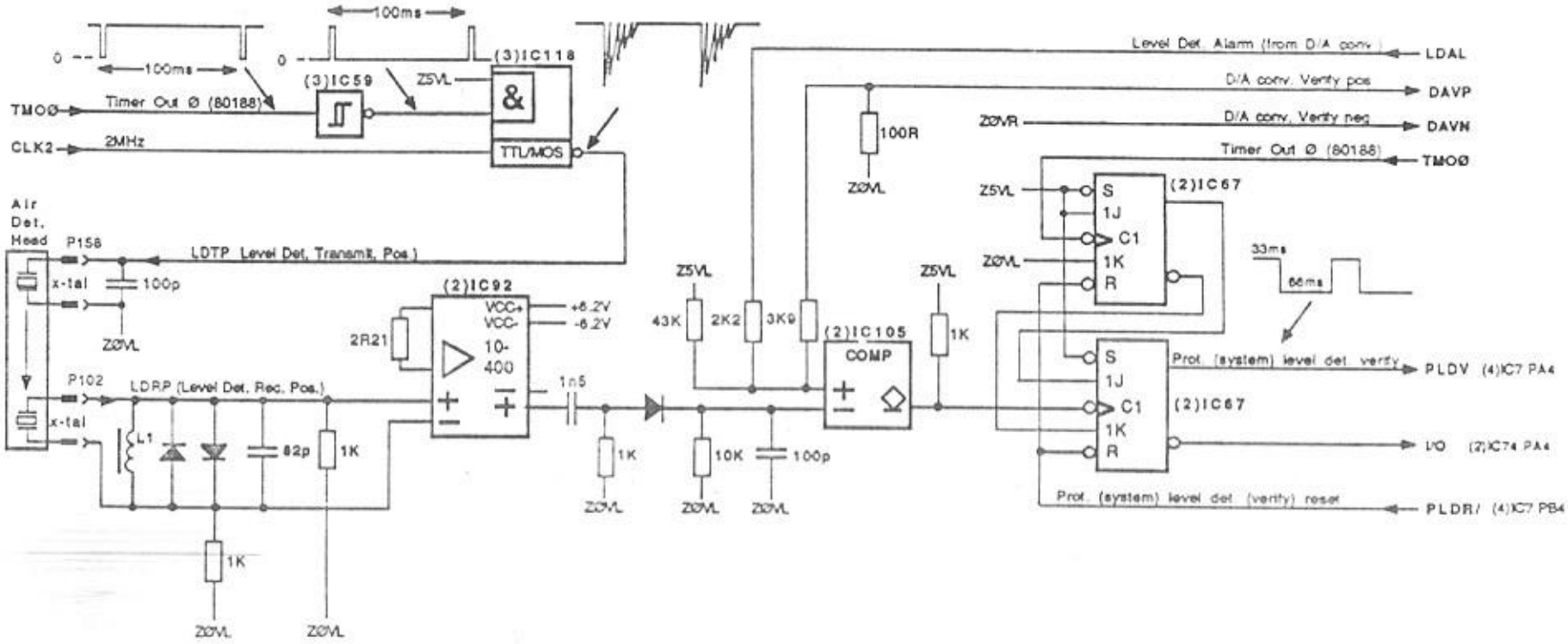


Arterial and venous line clamp control



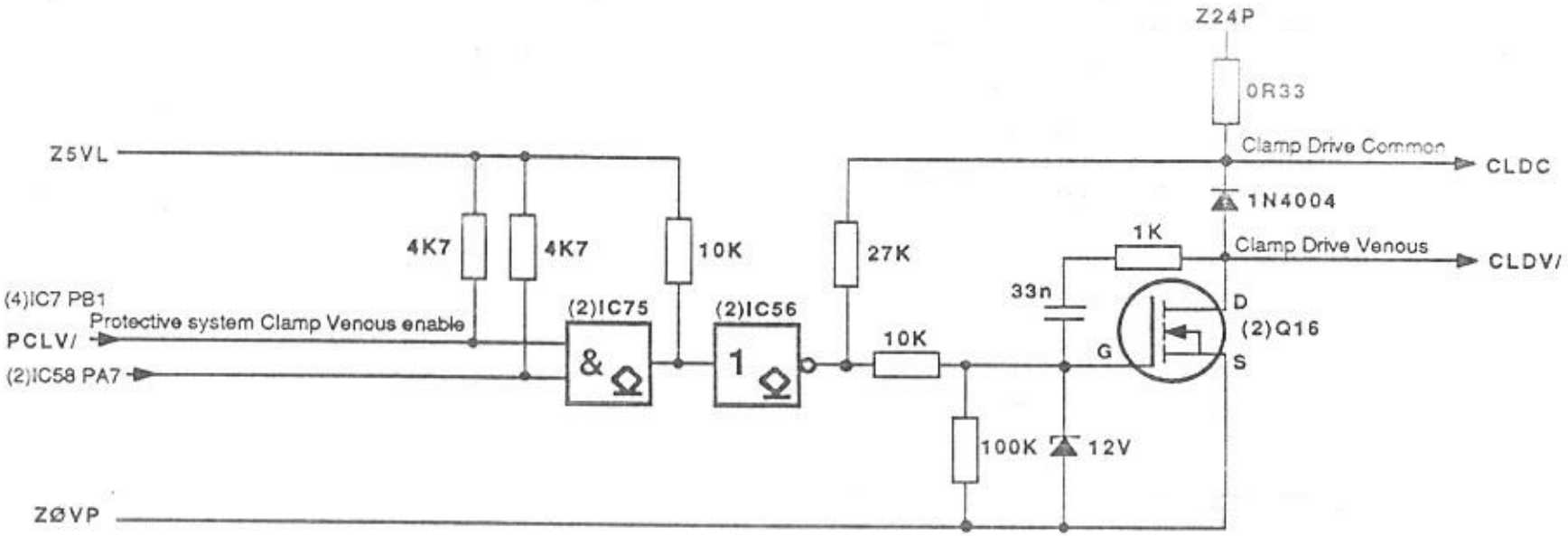
AK 100 BM Air detector circuit

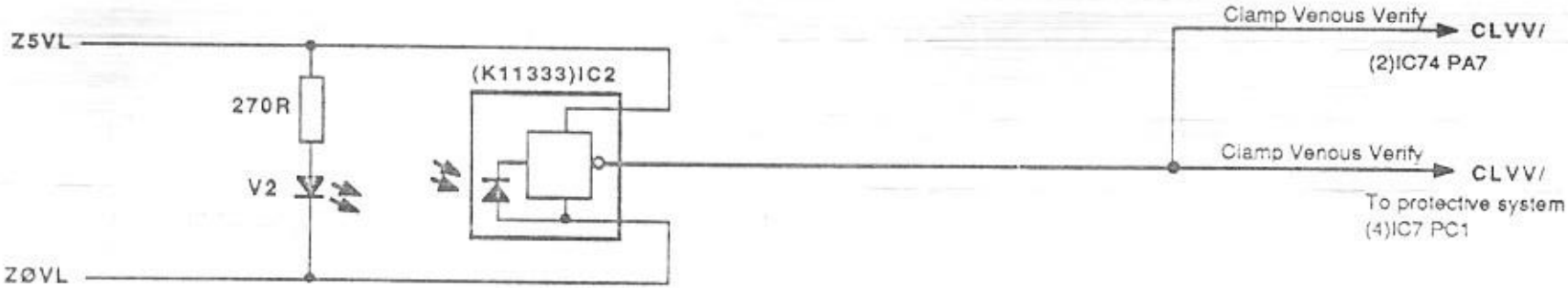
8.O. 02. 1988



AK 100 BM Venous Clamp circuit

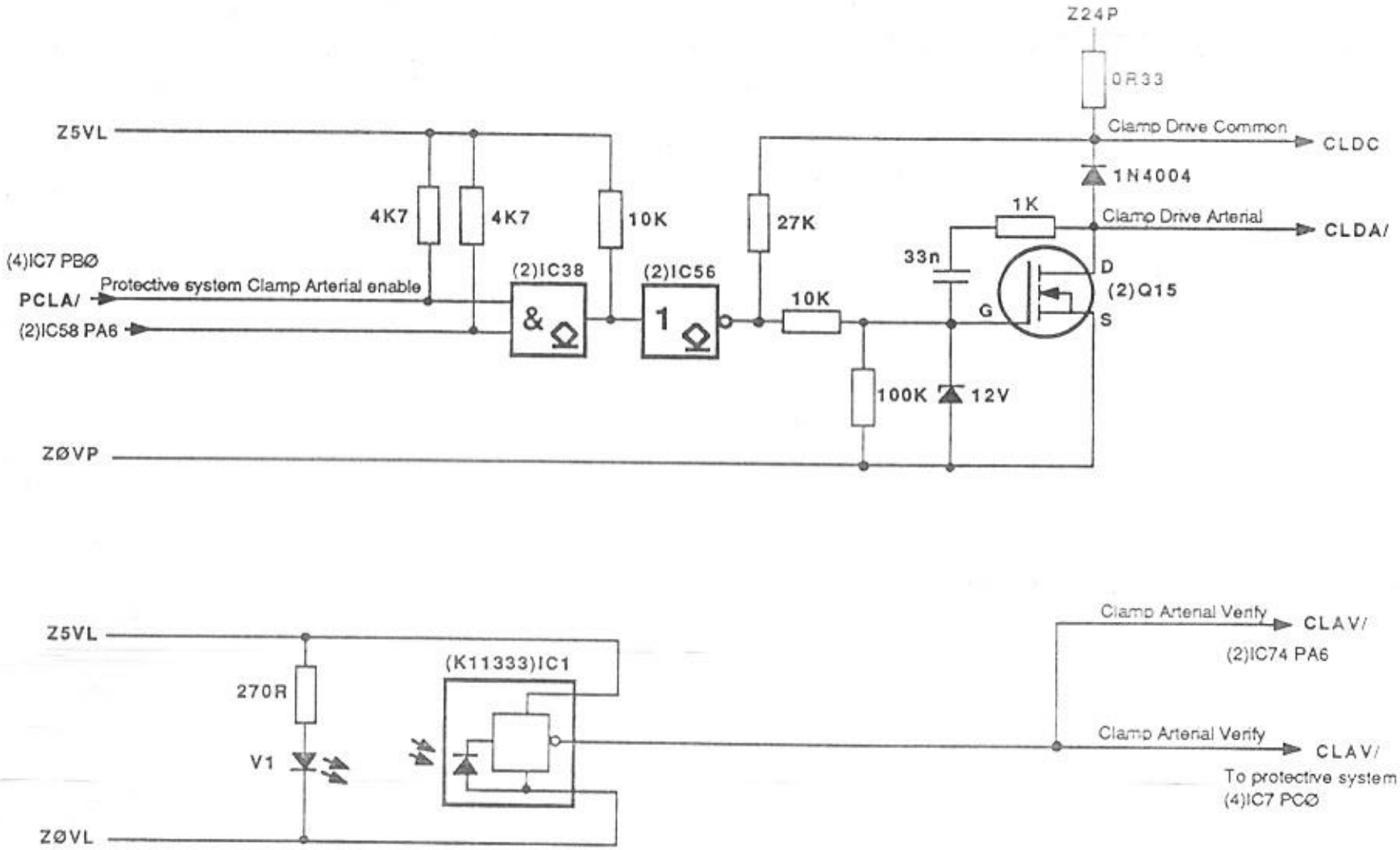
B.O. 02. 1988





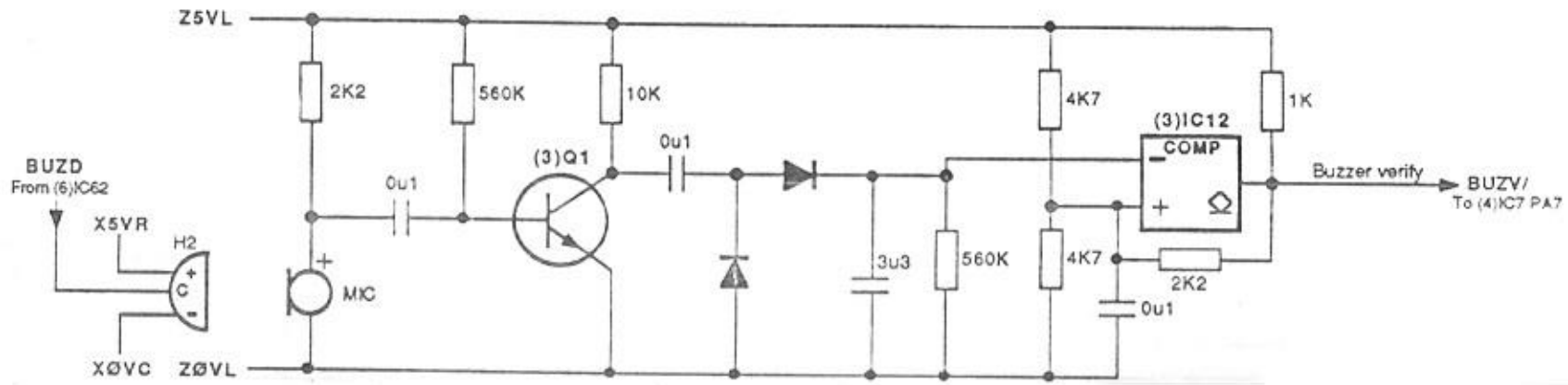
AK 100 BM Arterial Clamp circuit

B.O. 02. 1988

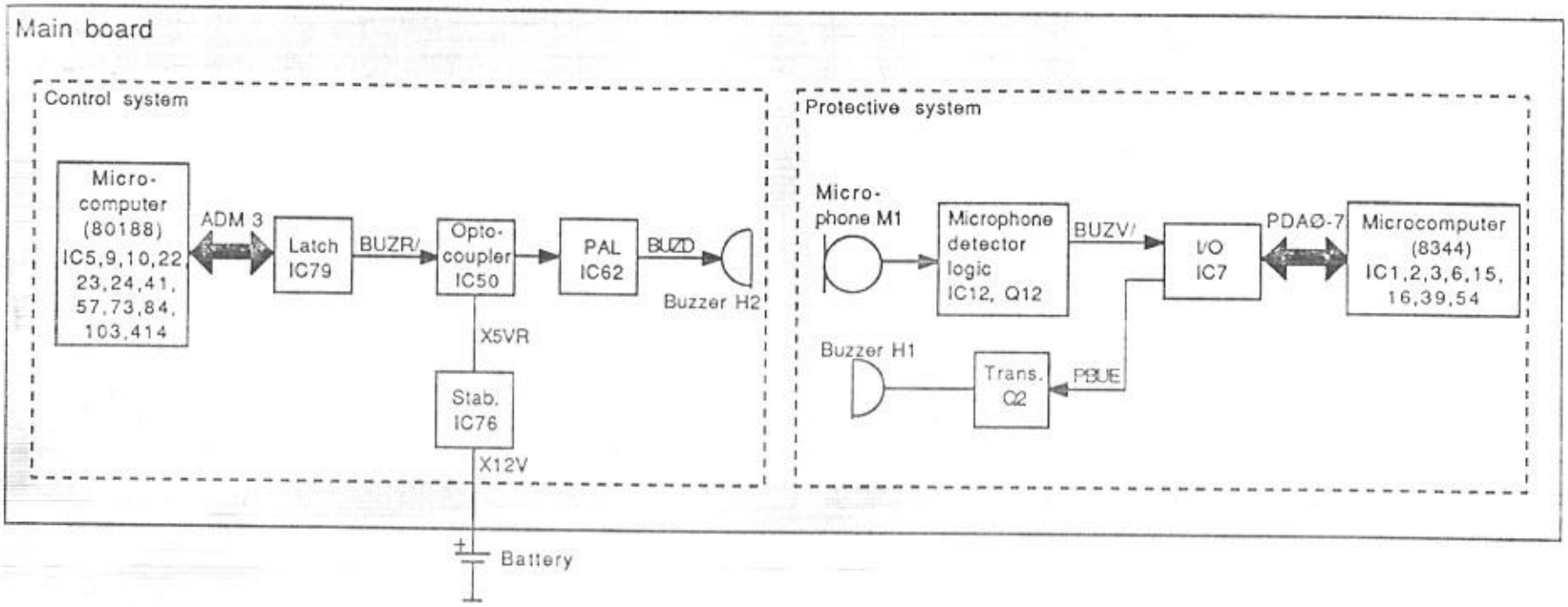


AK 100 BM Buzz(' circ it

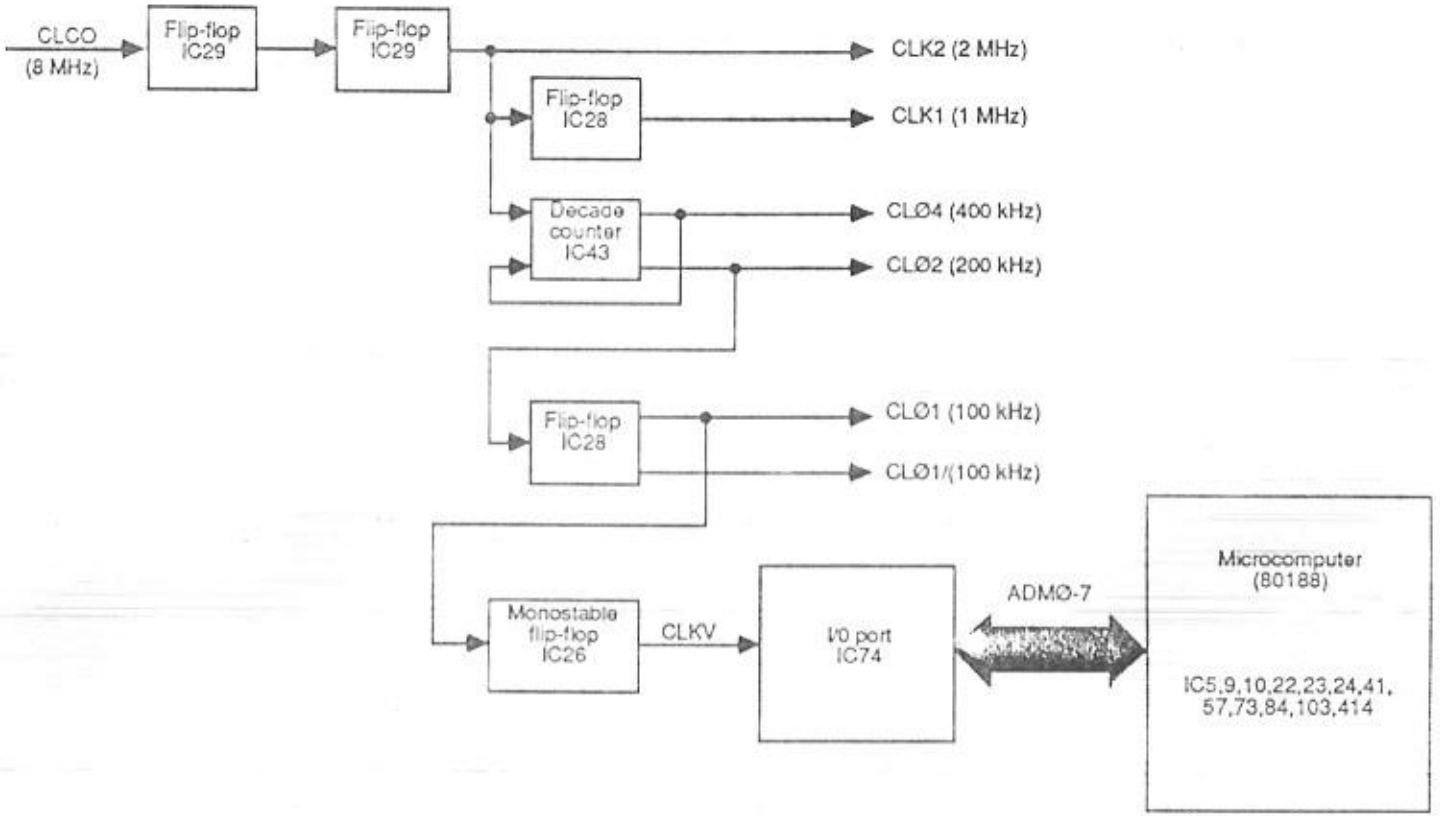
B.O. 02. 1988



Alarm buzzer control

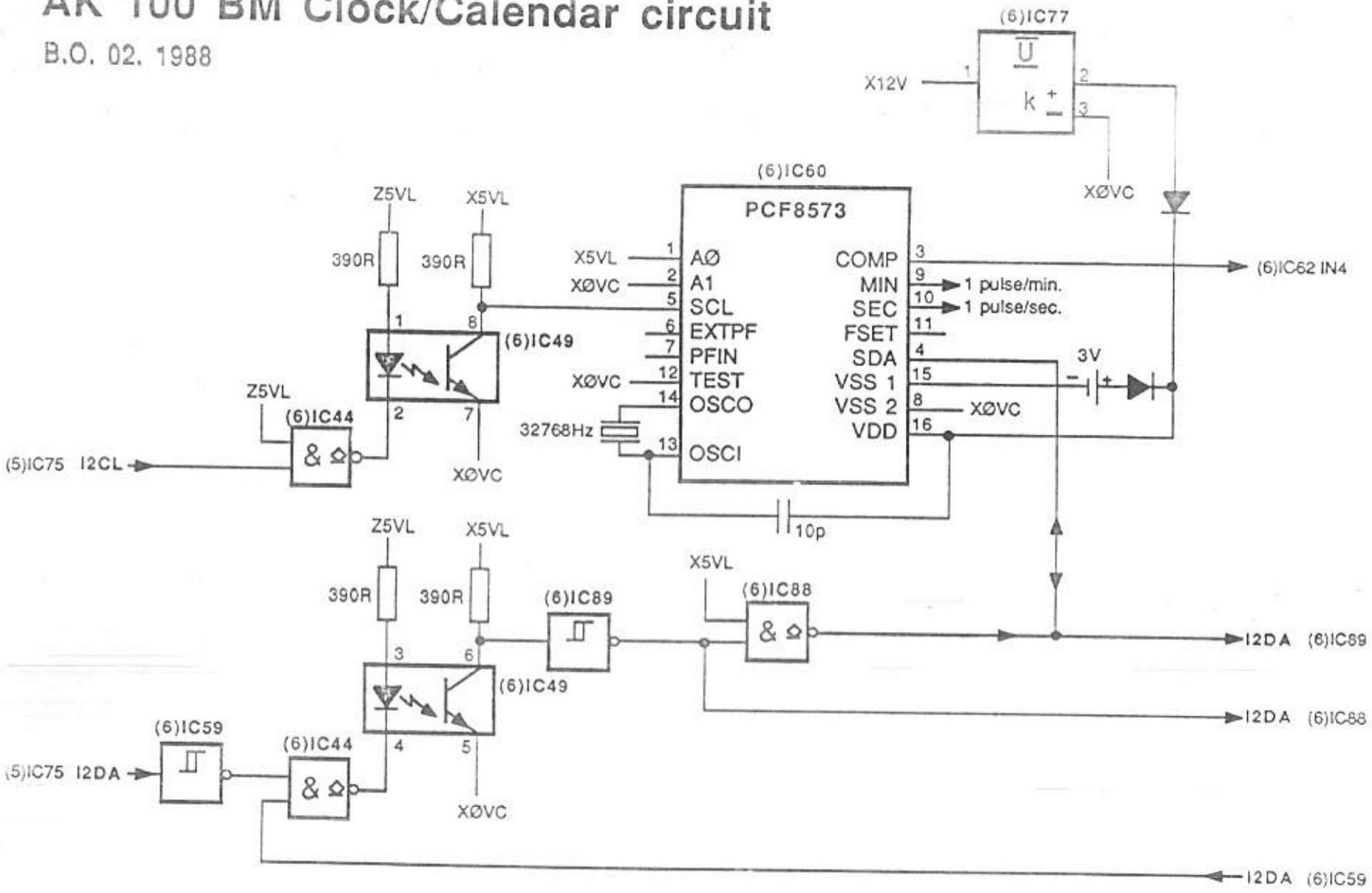


Clock pulse generation



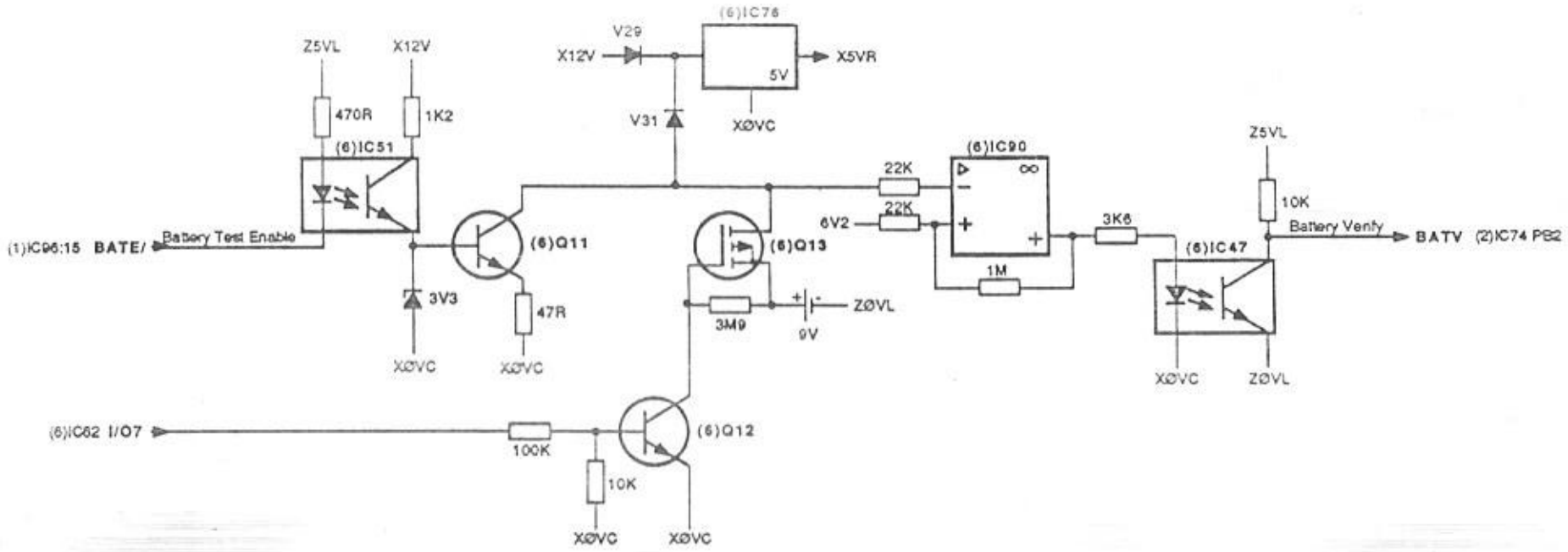
AK 100 BM Clock/Calendar circuit

B.O. 02. 1988



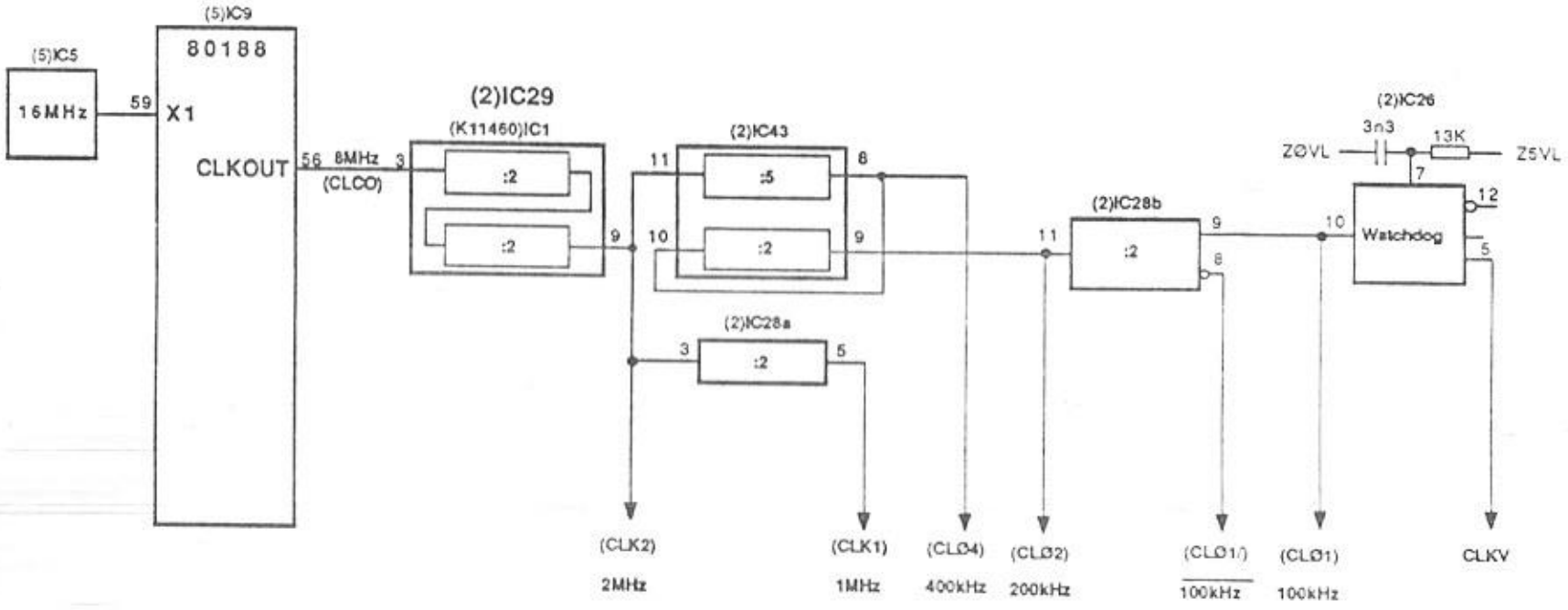
AK 100 BM Battery test circuit

B.O. 02. 1988

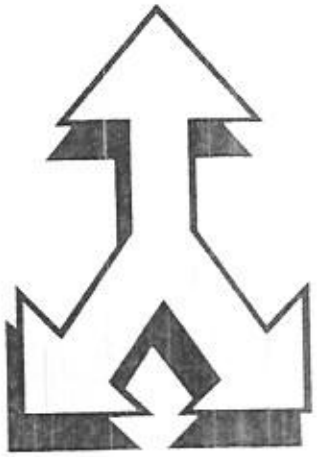


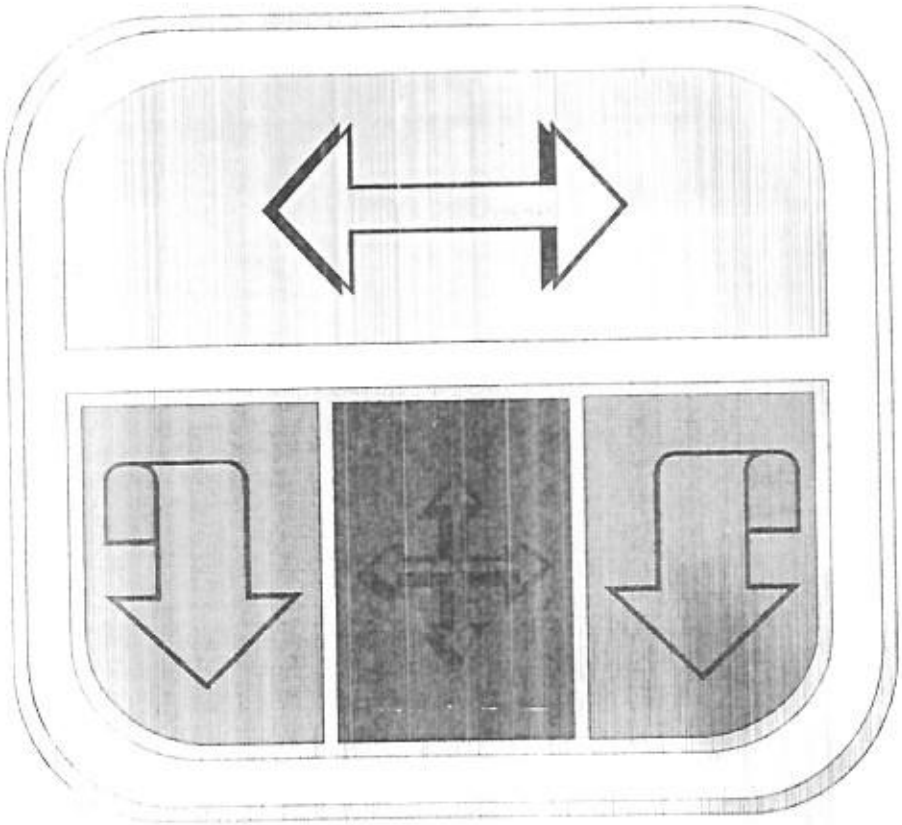
AK 100 BM Clockpulses

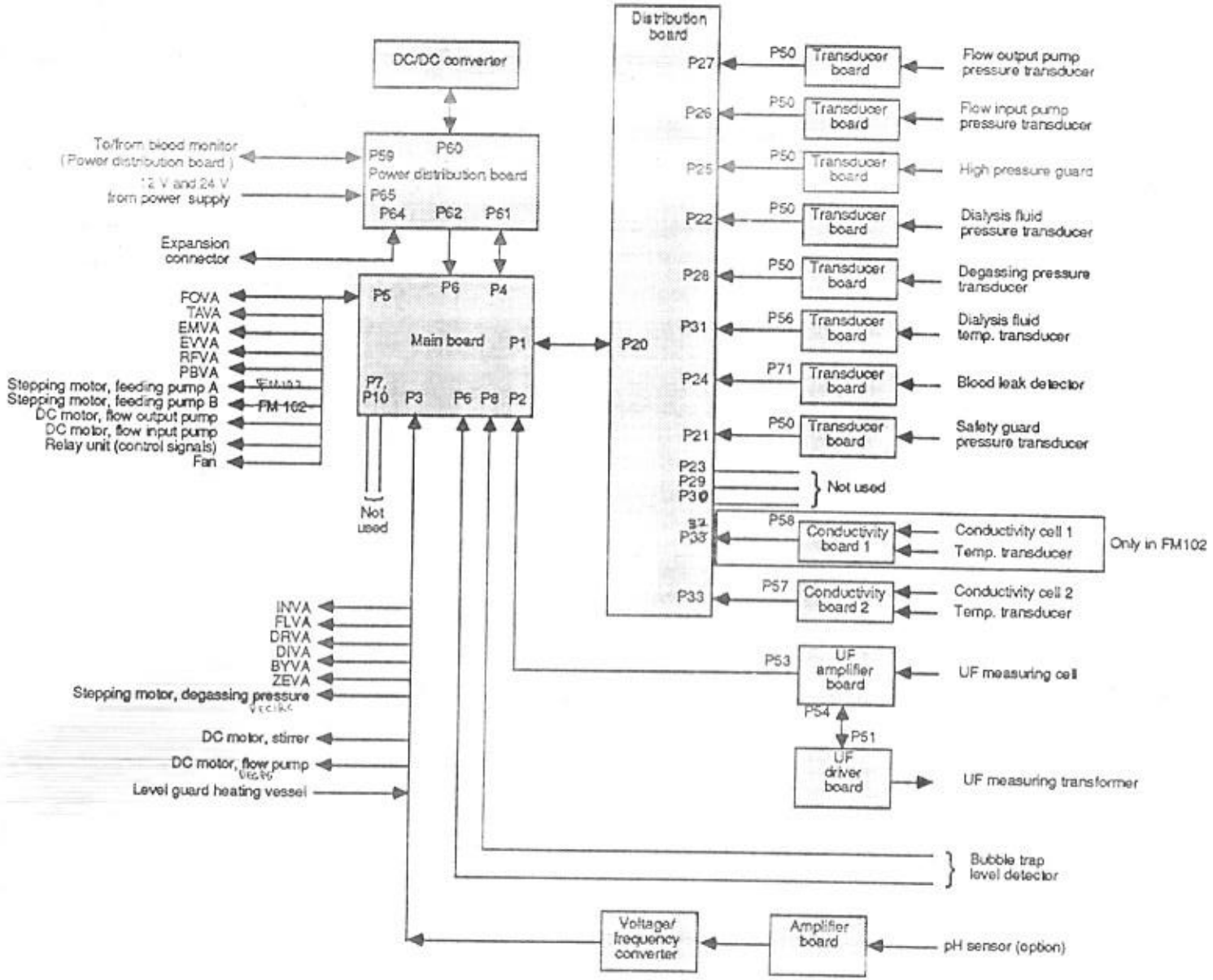
B.O. 02. 1988

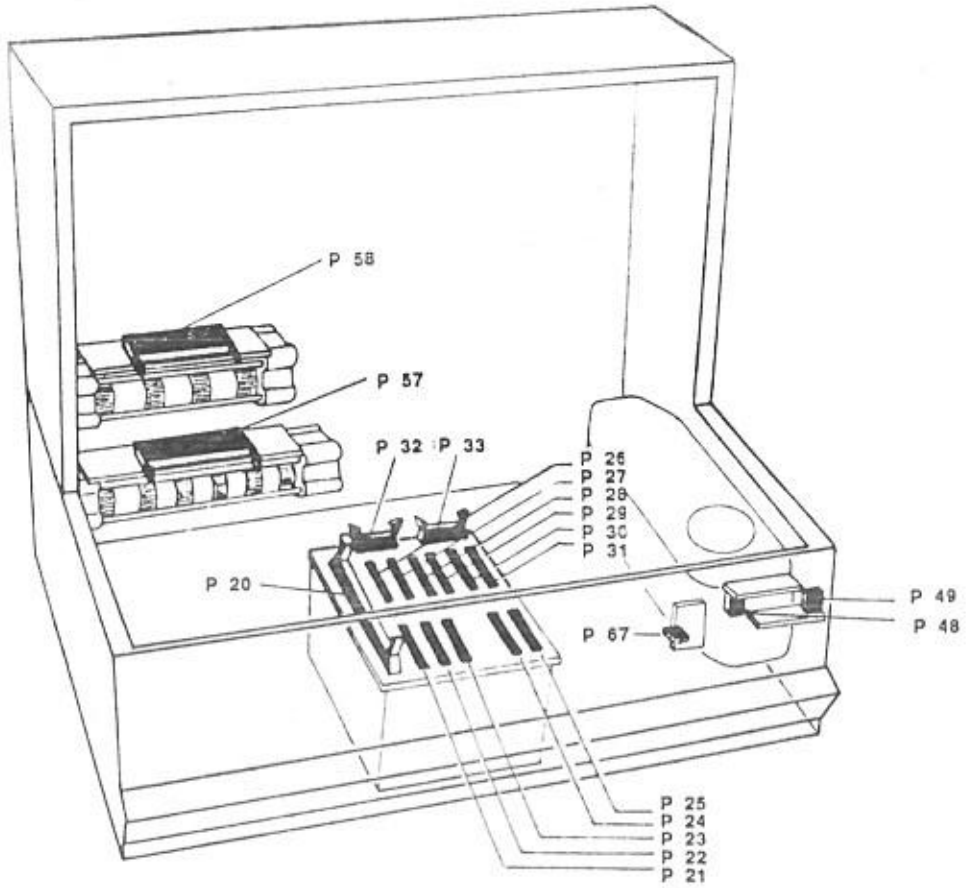


FM BLOCK DIAGRAM



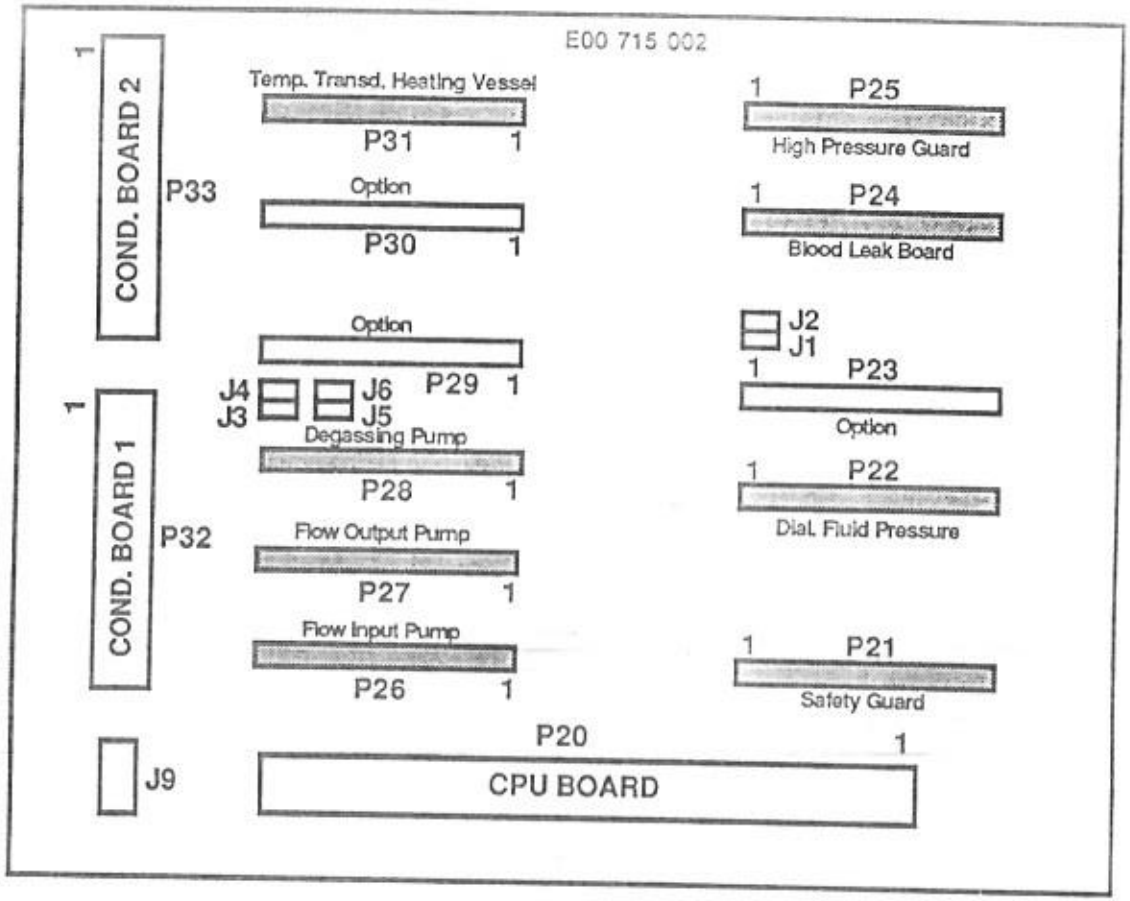


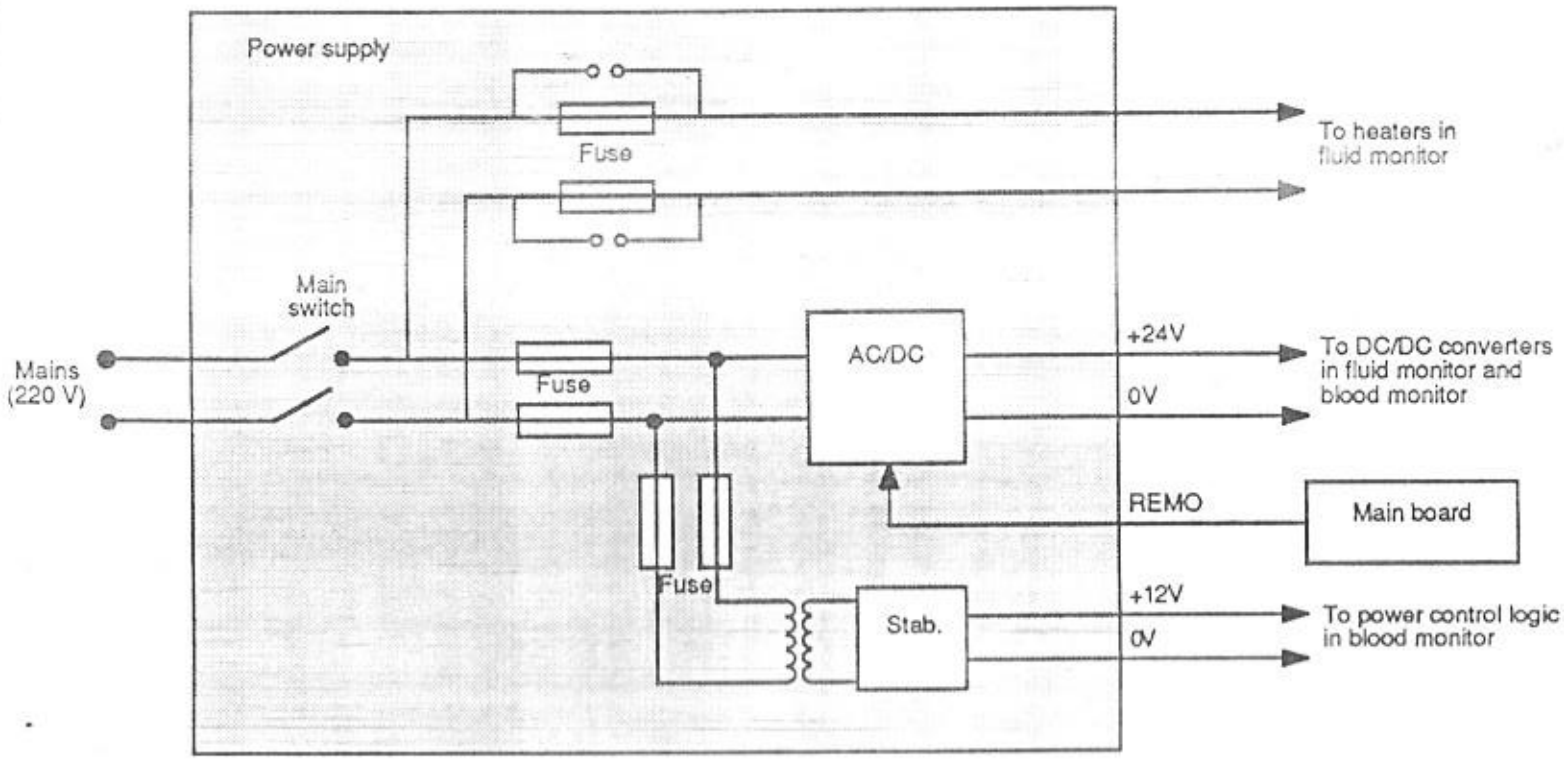

DC/DC converter
To/from blood monitor
(Power distribution board)
12 V and 24 V
from power supply
P59
P60
Power distribution board
P65
P64
P62
P61
Expansion
connector
P5
P6
P4
Main board
P1
P7,
P10
P3
P6
P8
P2
FOVA
TAVA
EMVA
EVVA
RFVA
PBVA
Stepping motor, feeding pump A
Stepping motor, feeding pump B
FM-102
DC motor, flow output pump
DC motor, flow input pump
Relay unit (control signals)
Fan
Not
used
INVA
FLVA
DRVA
DIVA
BYVA
ZEVA
Stepping motor, degassing pressure
DC motor, stirrer
DC motor, flow pump
Level guard heating vessel
Distribution
board
P20
P27
P26
P25
P22
P28
P31
P24
P21
P23
P29
P30
P32
P33
P50
Transducer
board
Flow output pump
pressure transducer
Flow input pump
pressure transducer
High pressure guard
Dialysis fluid
pressure transducer
Degassing pressure
transducer
P56
Dialysis fluid
temp. transducer
P71
Blood leak detector
Safety guard
pressure transducer
Not used
P58
Conductivity
board 1
Conductivity cell 1
Temp. transducer
Only in FM102
P57
Conductivity
board 2
Conductivity cell 2
Temp. transducer
P53
UF
amplifier
board
UF measuring cell
P54
P51
UF
driver
board
UF measuring transformer
Bubble trap
level detector
Voltage/
frequency
converter
Amplifier
board
pH sensor (option)

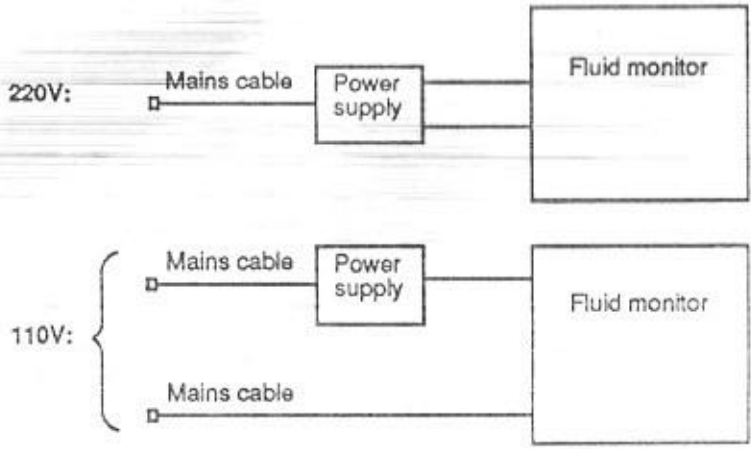

P 58
P 57
P 32
P 33
P 26
P 27
P 28
P 29
P 30
P 31
P 20
P 49
P 48
P 67
P 25
P 24
P 23
P 22
P 21

AK 100 FM Distribution Board

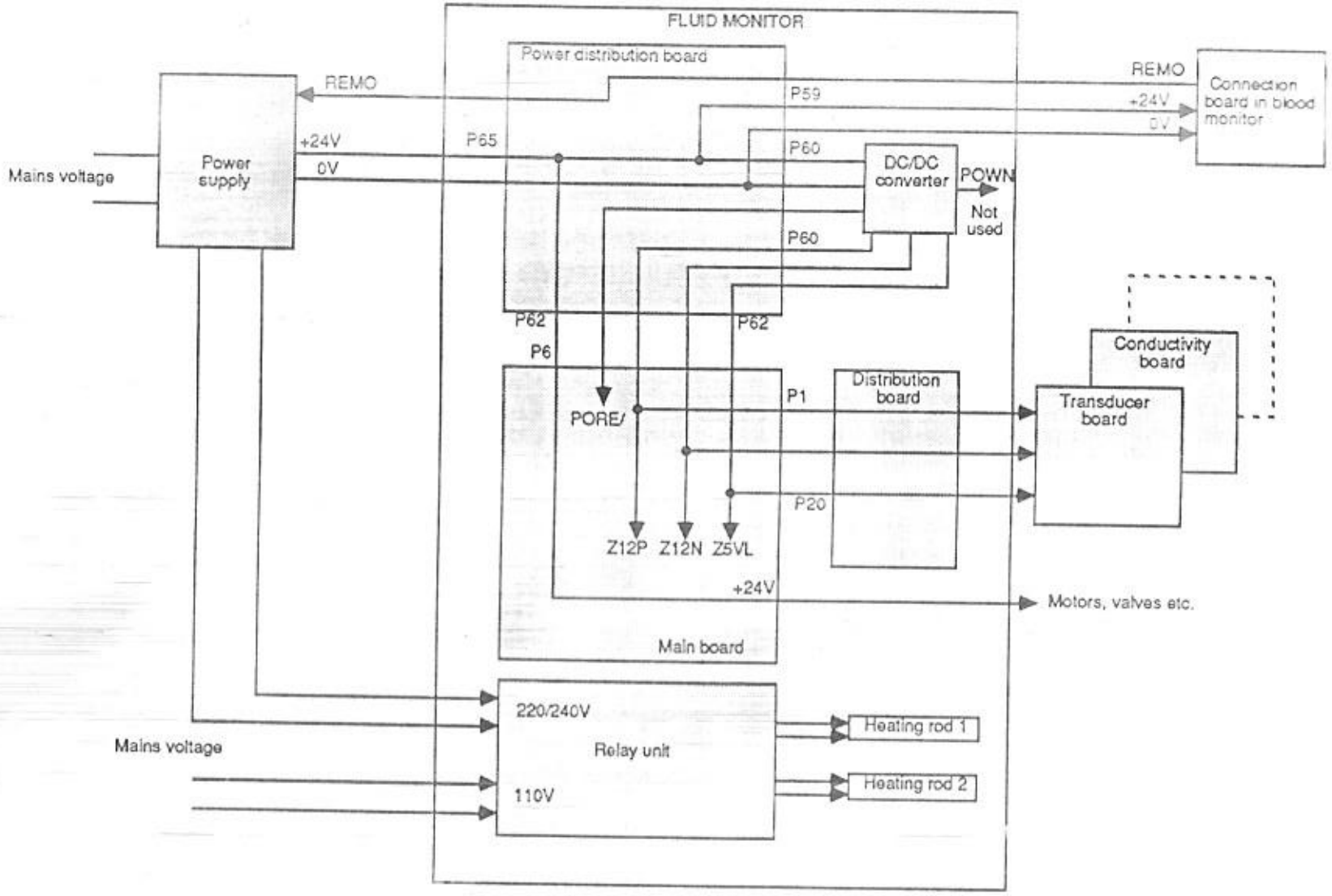
B.O. 06. 1988



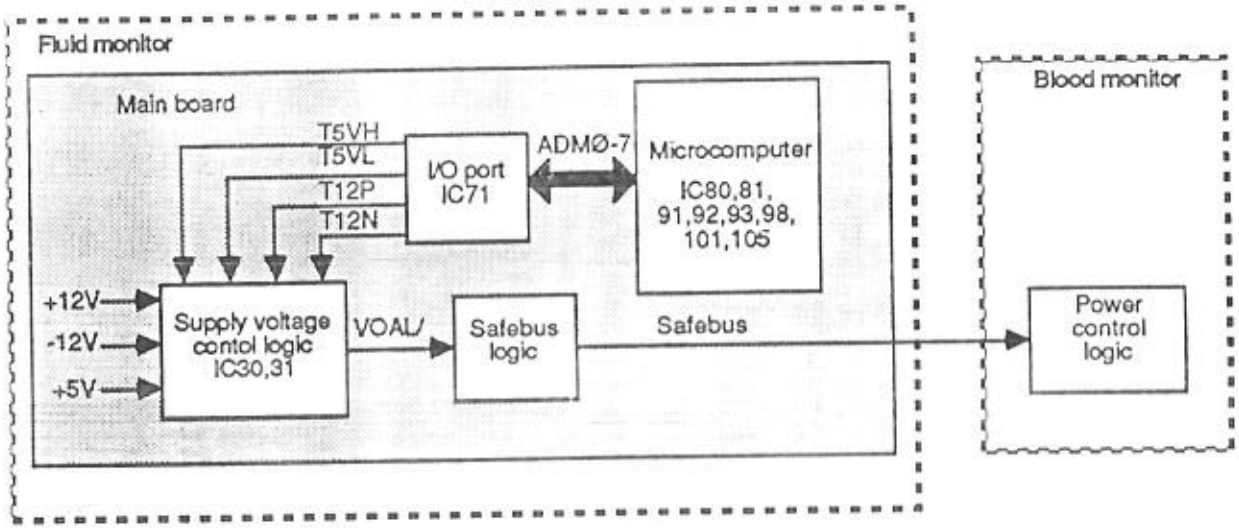

Power supply
Fuse
To heaters in fluid monitor
Main switch
Mains (220 V)
Fuse
AC/DC
+24V
0V
To DC/DC converters in fluid monitor and blood monitor
REMO
Main board
Fuse
Stab.
+12V
0V
To power control logic in blood monitor


220V:
Mains cable
Power supply
Fluid monitor
110V:
Mains cable
Power supply
Fluid monitor
Mains cable

Supply voltages, fluid monitor

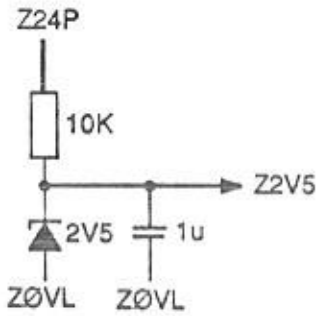


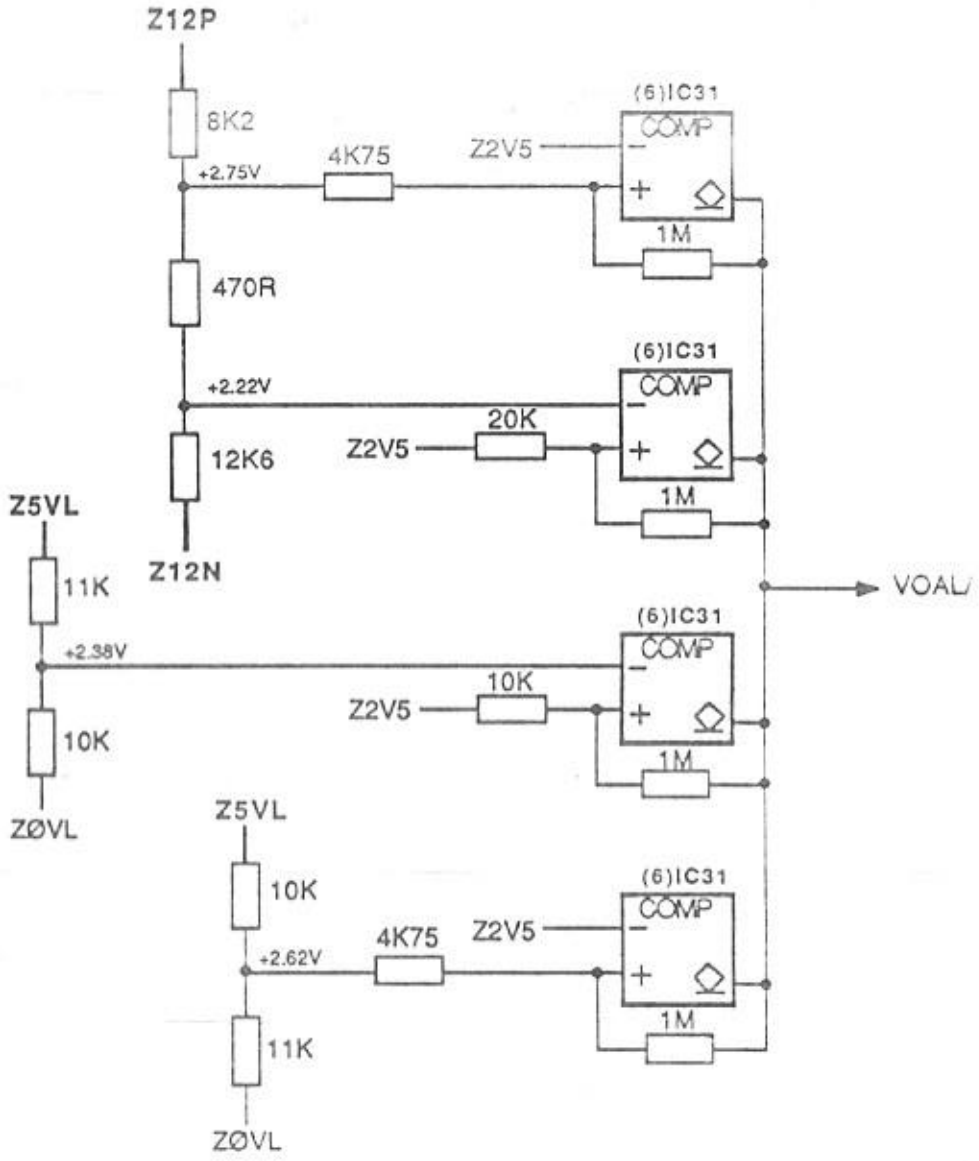
Supply voltage monitoring



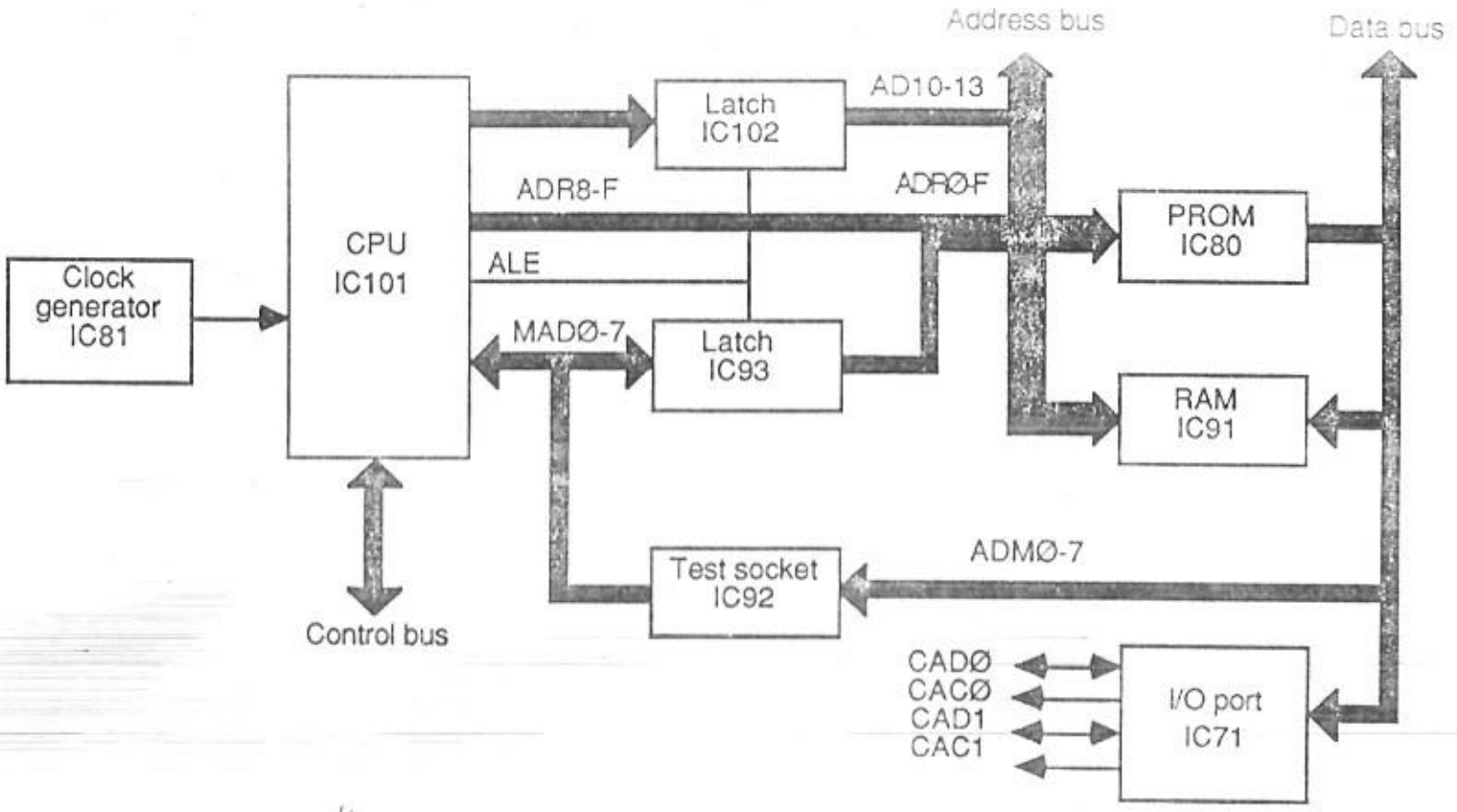
AK 100 FM Supply voltage monitoring

B.O. 05. 1987

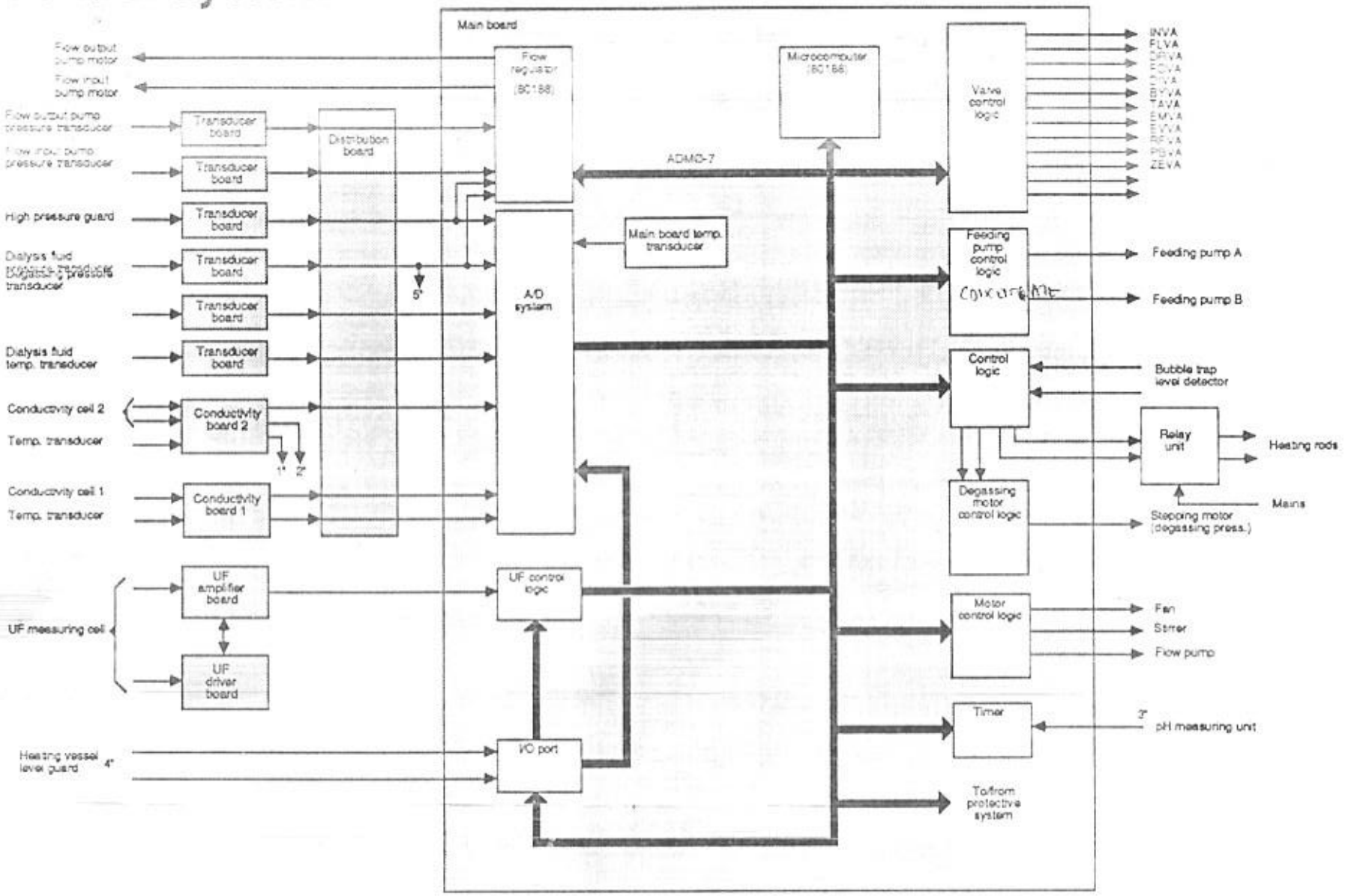




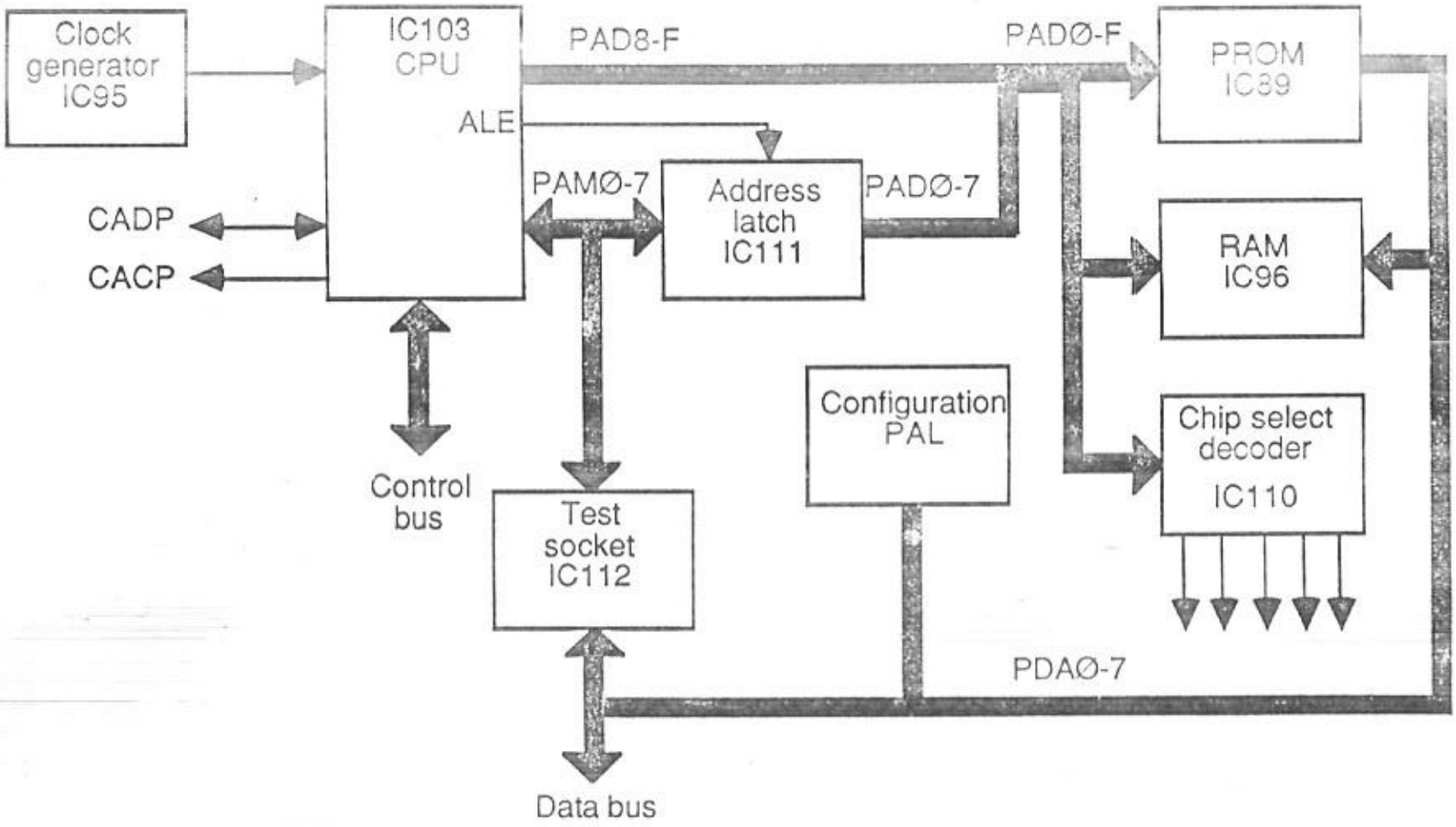
Micro-processor (Control System)



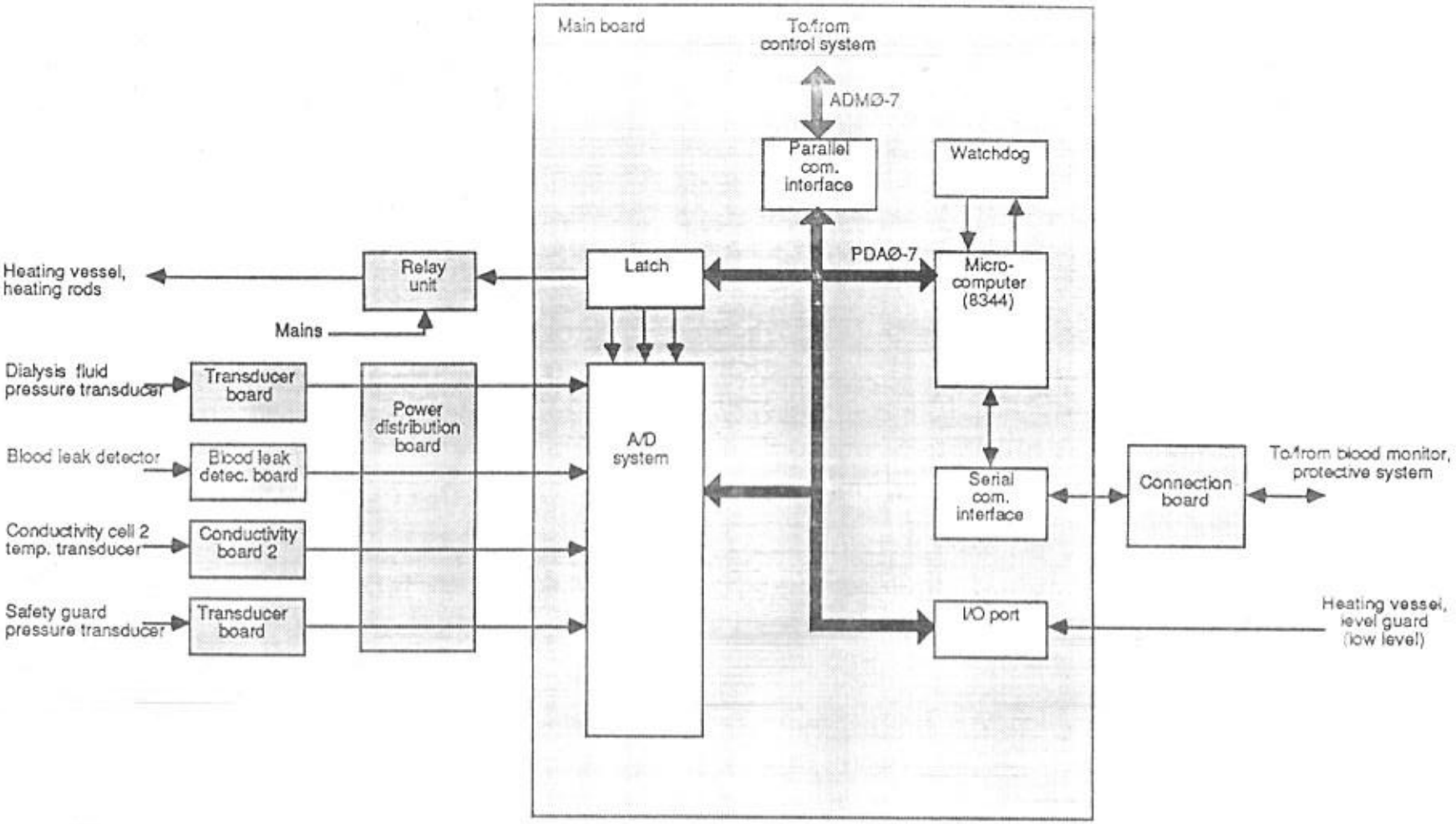
Control System



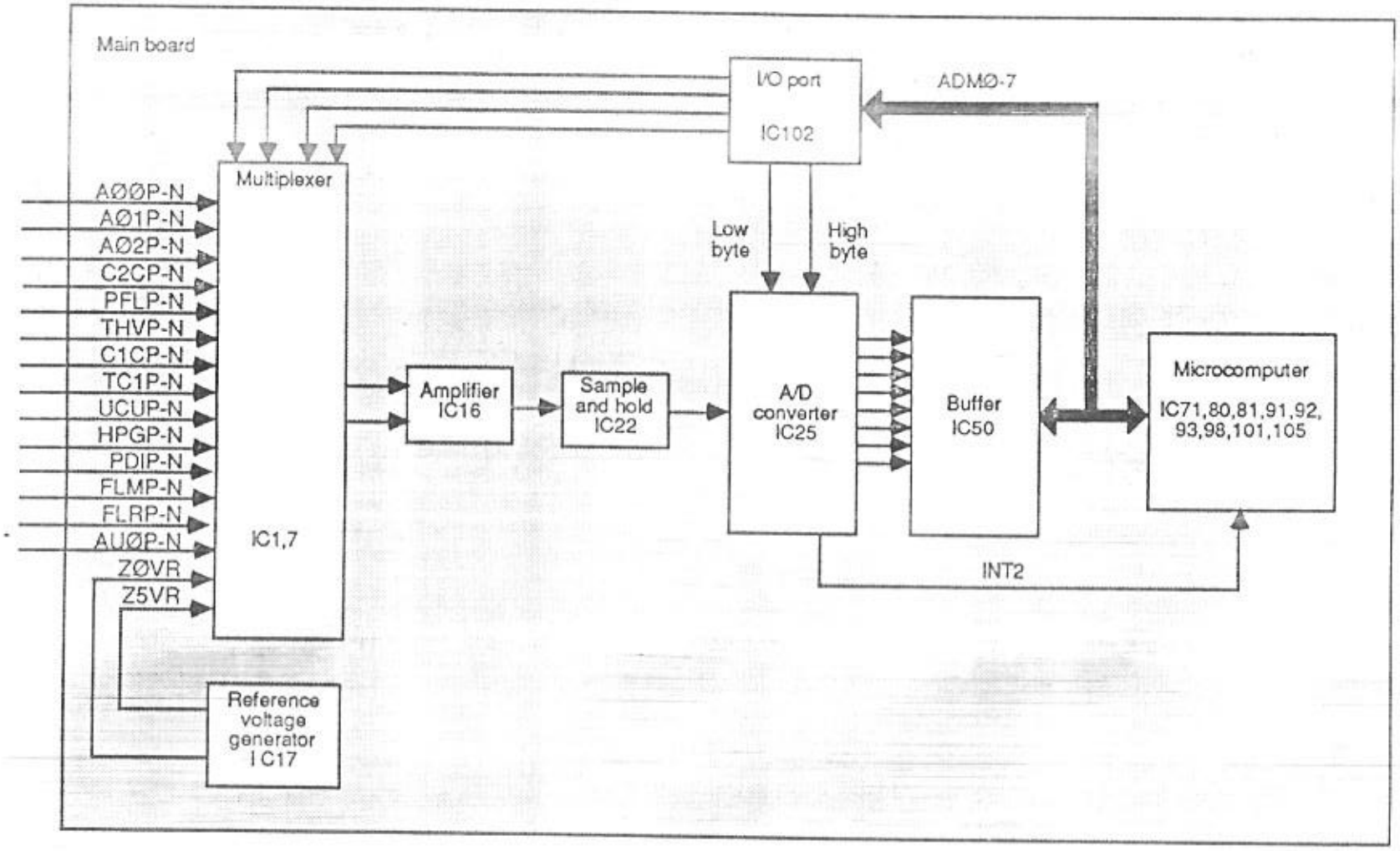
Microprocessor (protective system)



Protective System

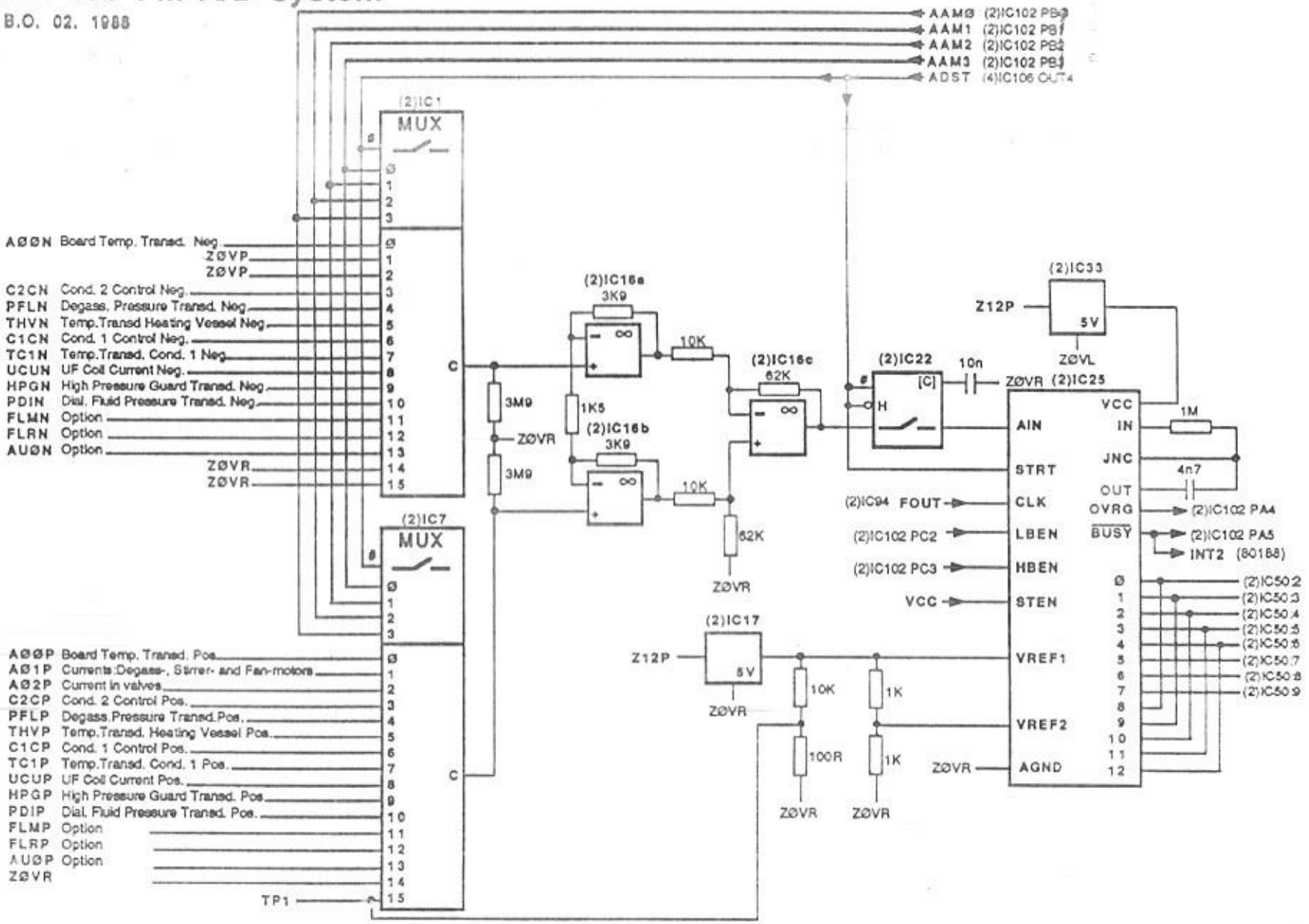


A/D System (Control system)



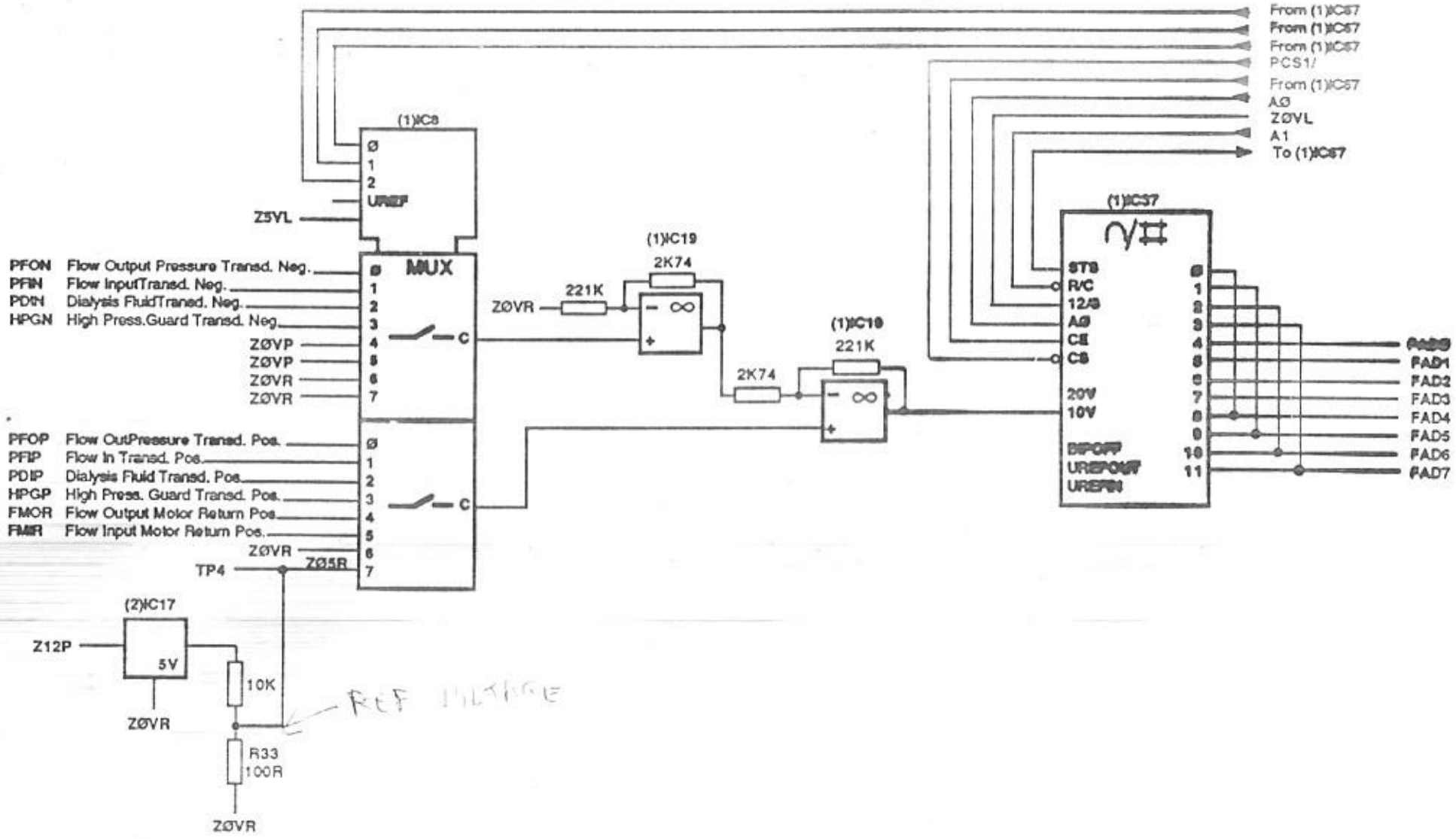
AK 100 FM A/D system

B.O. 02. 1988

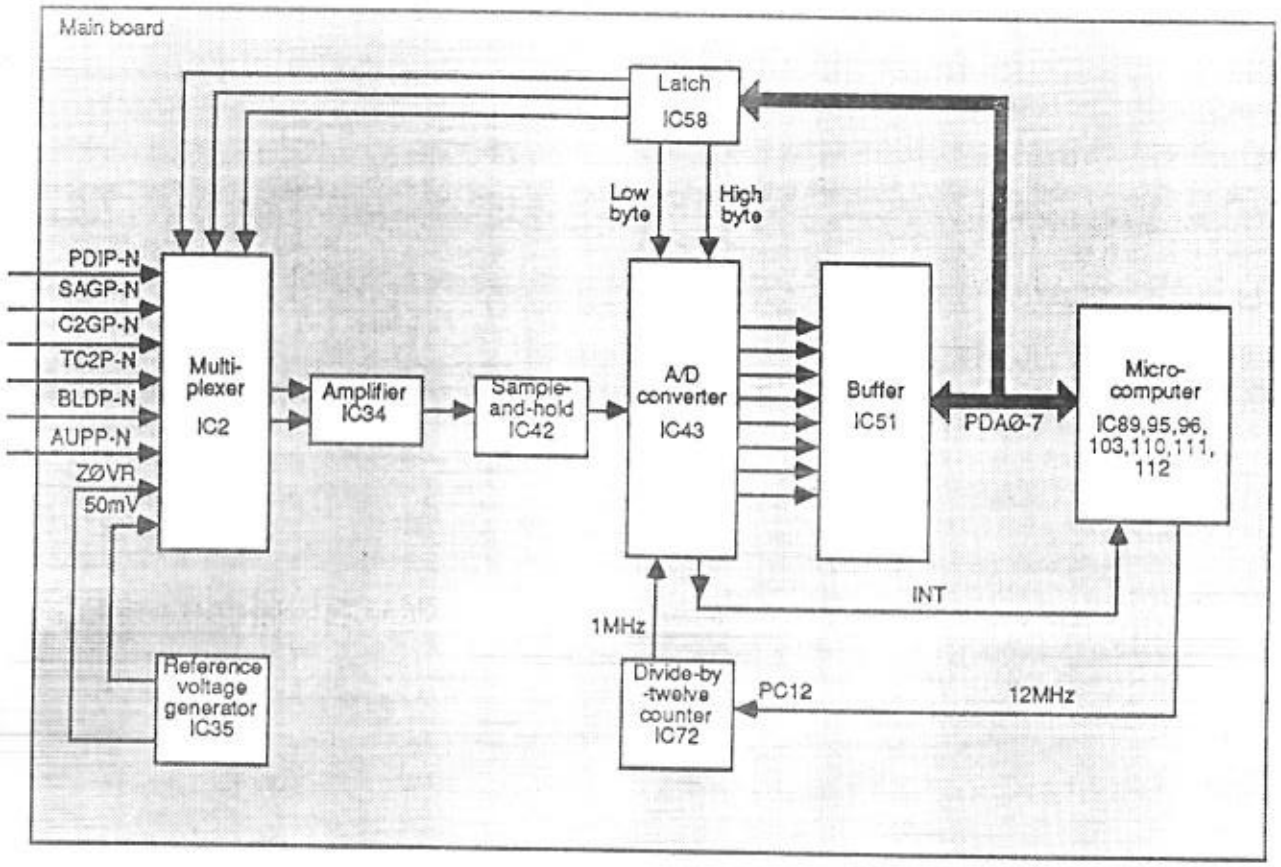


AK 100 FM A/D system (flow system)

B.O. 06. 1988

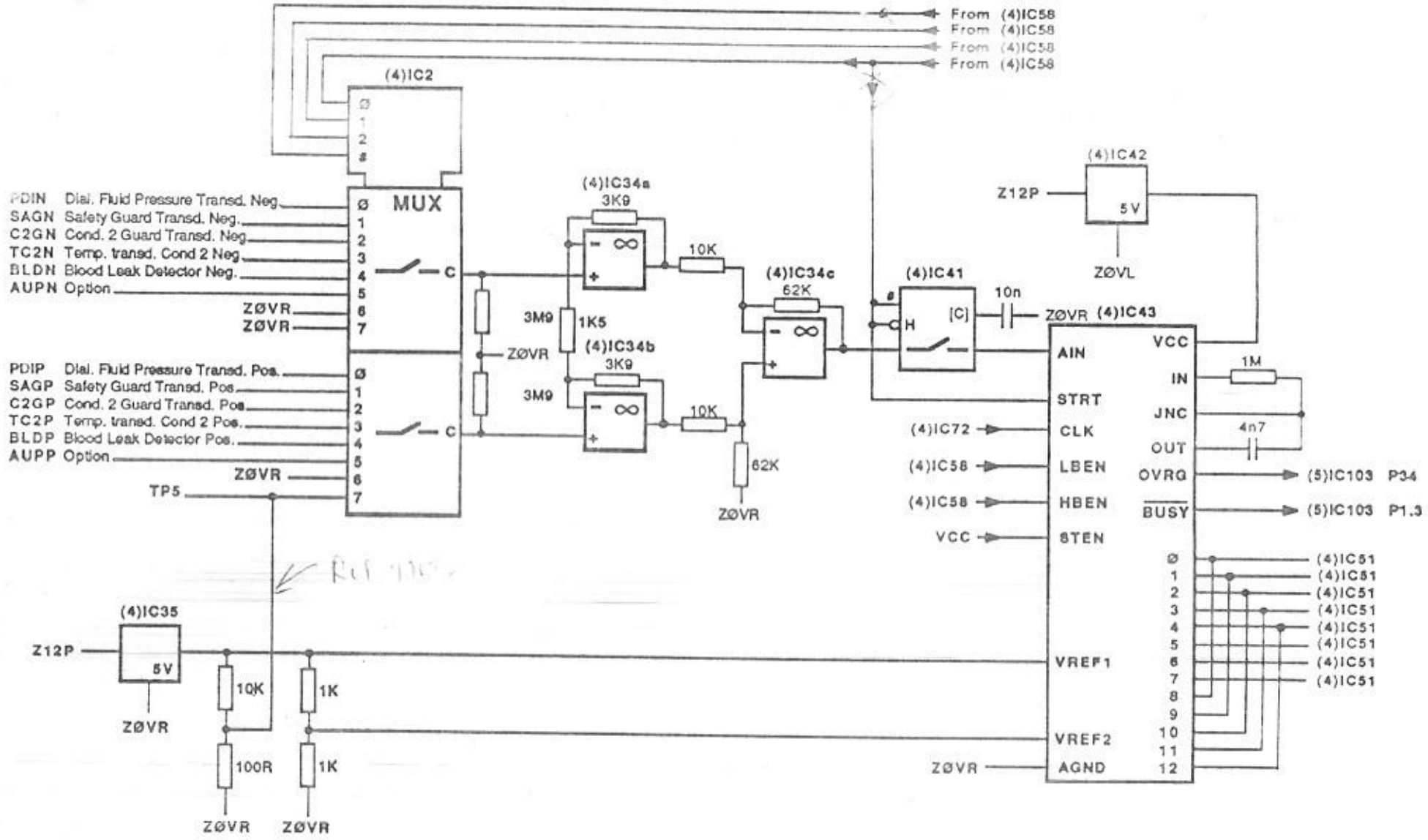


A/D System (Protective system)

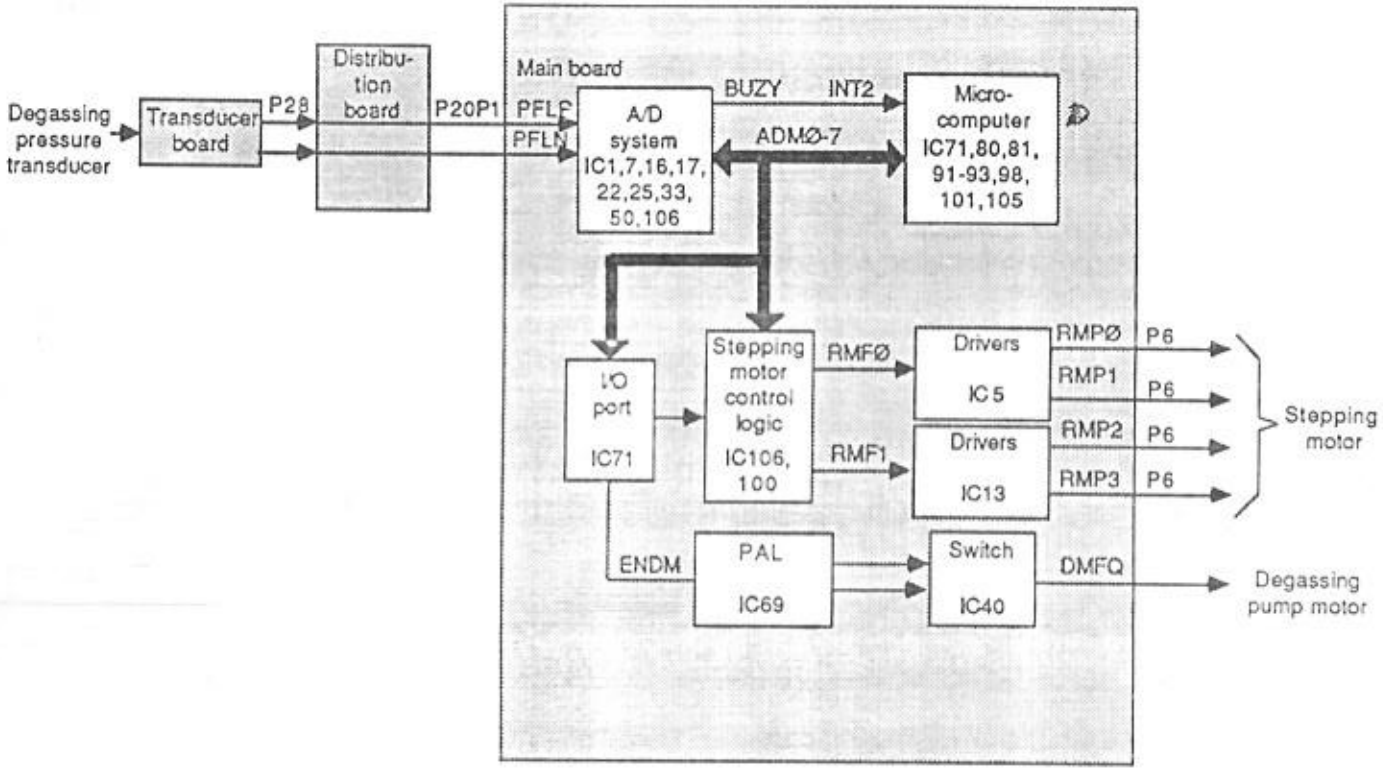


AK 100 FM A/D system(protective system)

B.O. 02. 1988

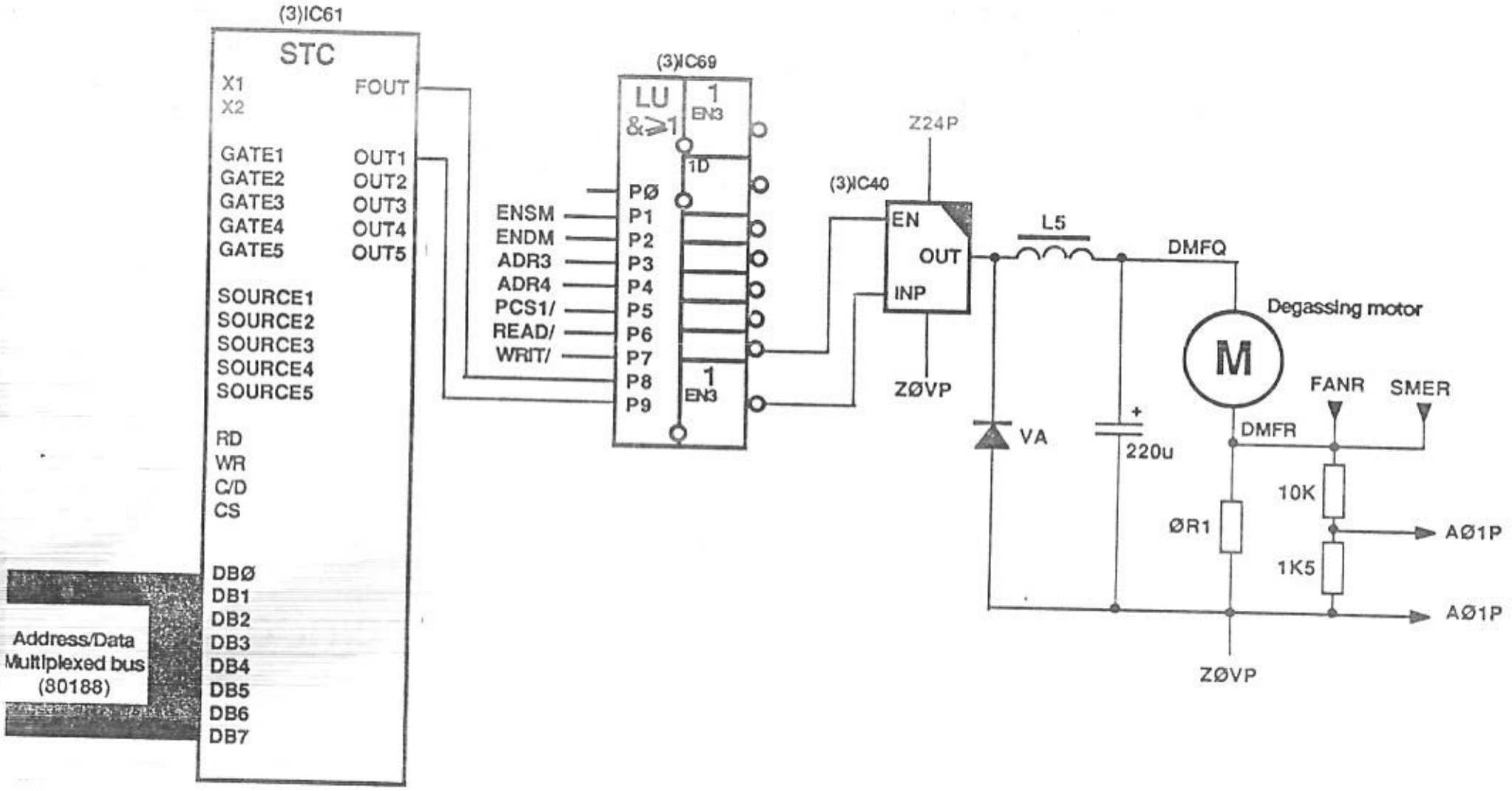


)egassing pressure monitoring
nd regulation



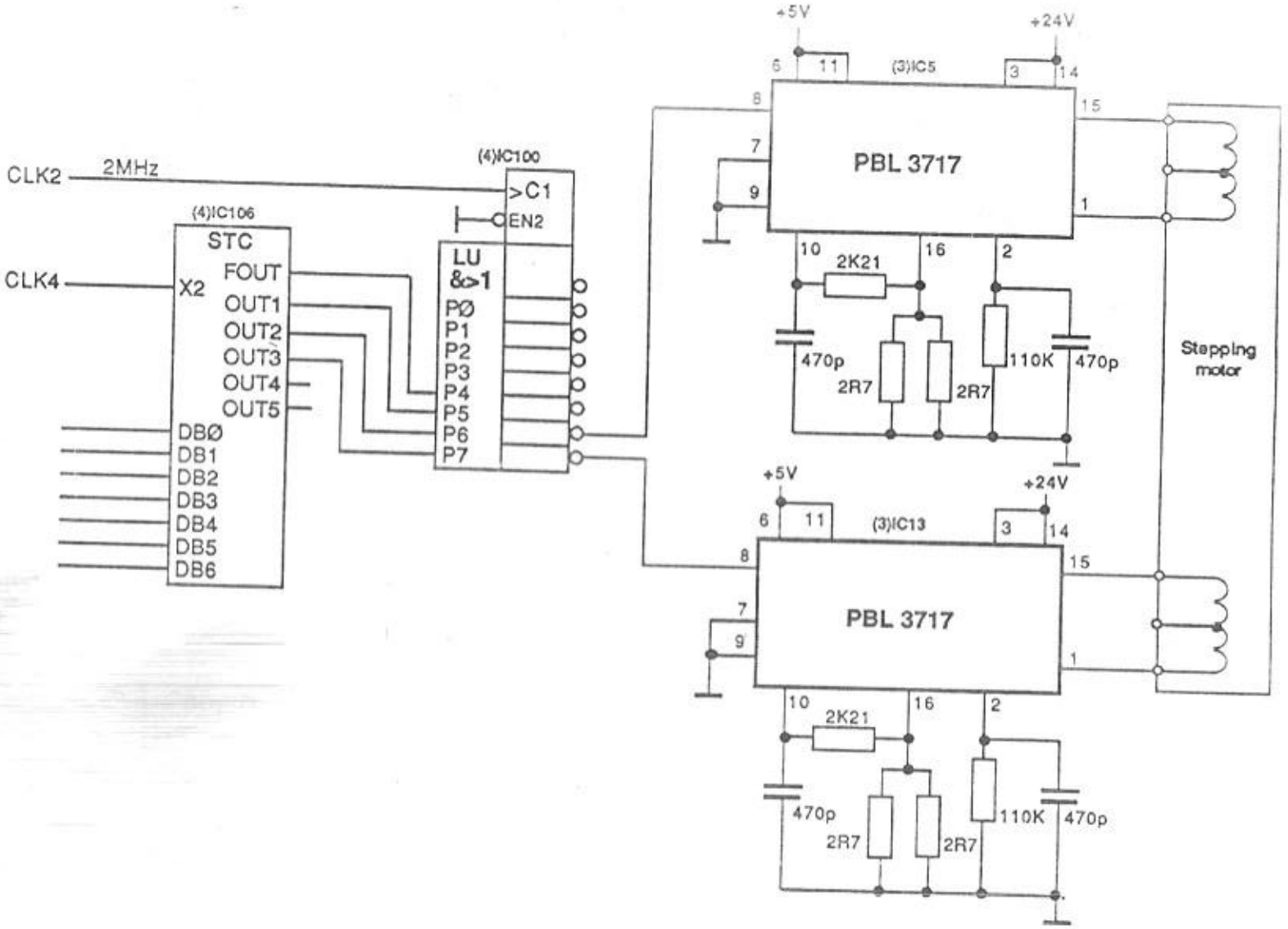
K100 FM Degassing pump circuit

). 06. 1988

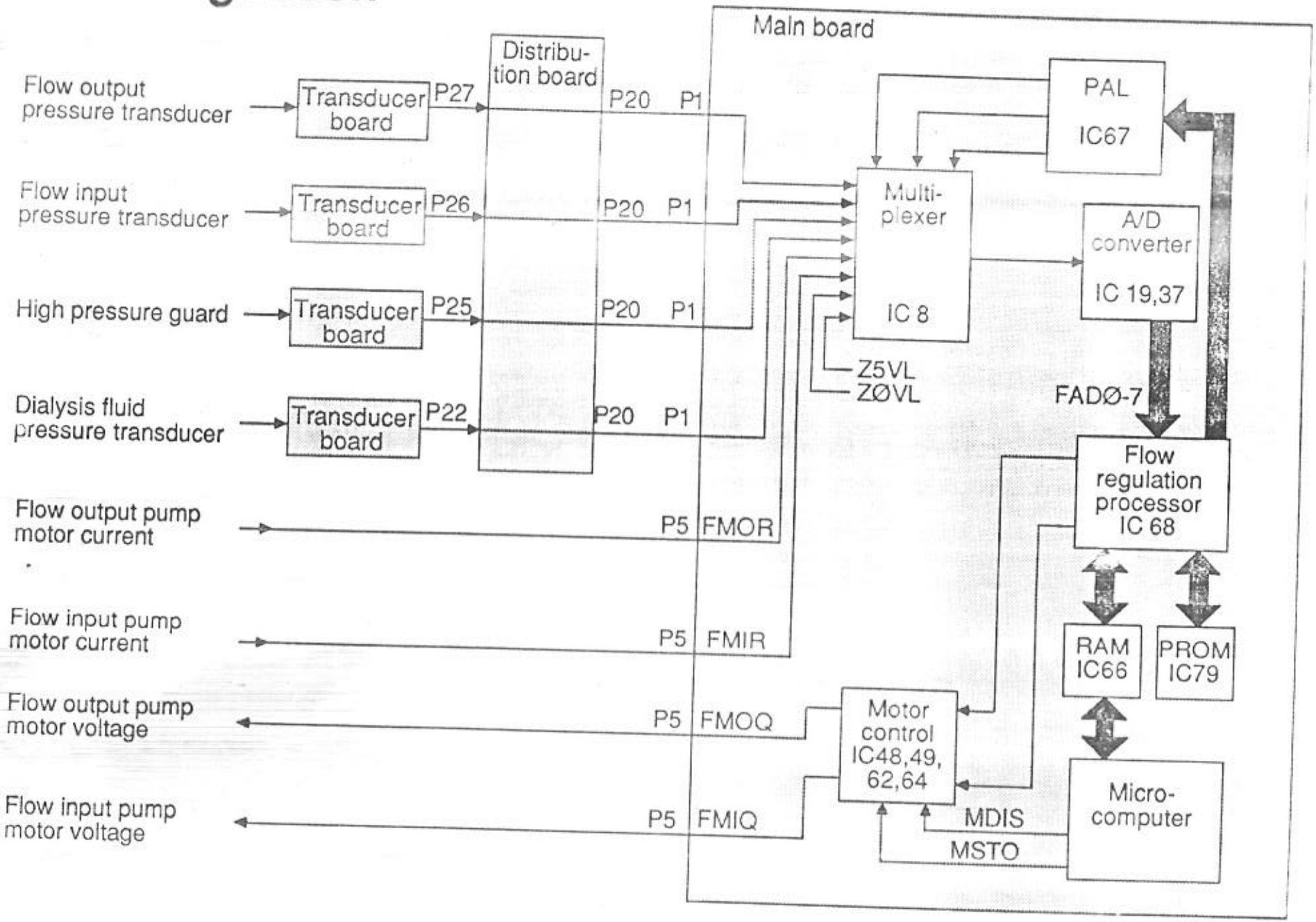


AK 100 FM Flow reduction

B.O. 02. 1988

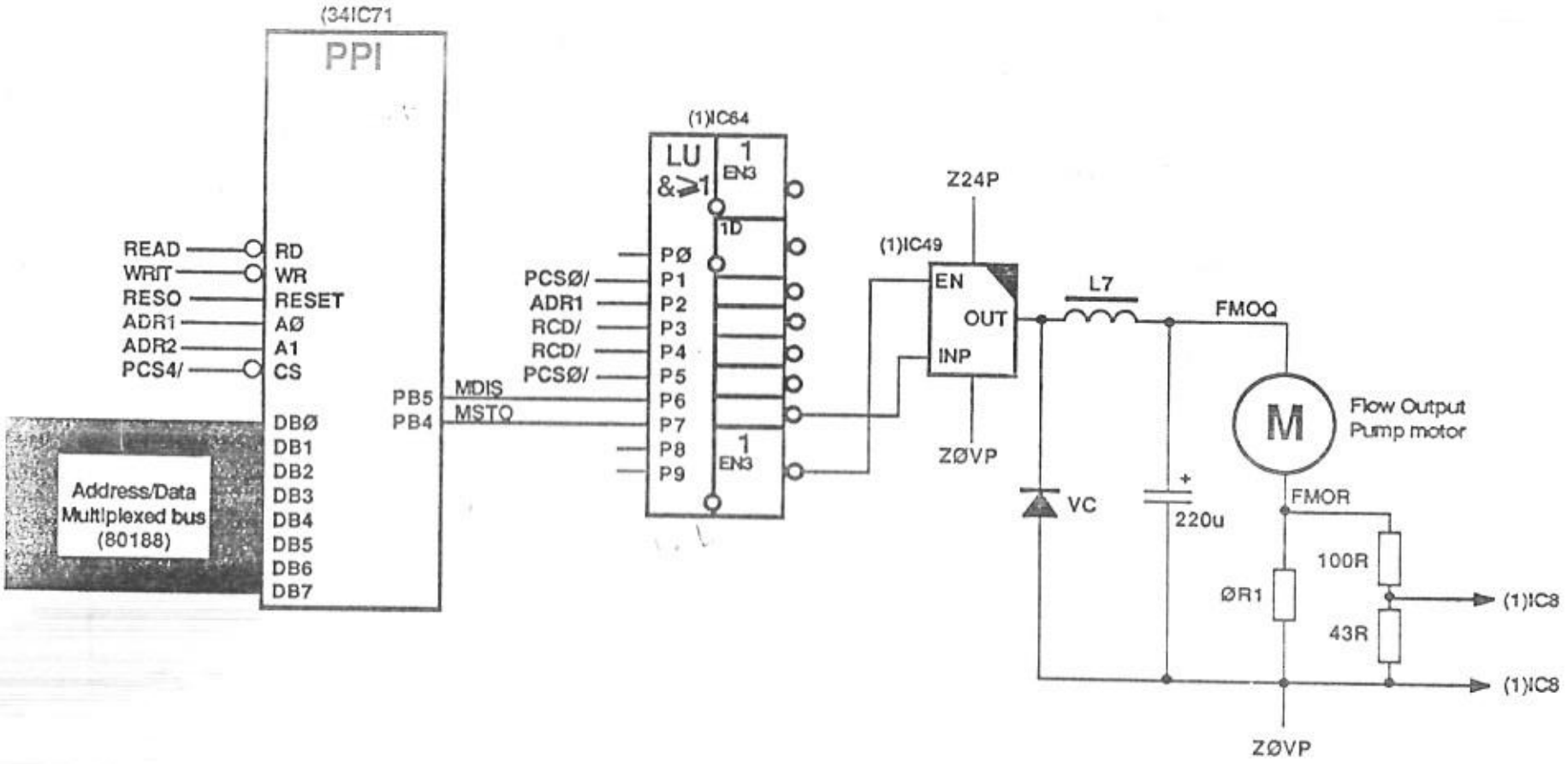


Flow regulation



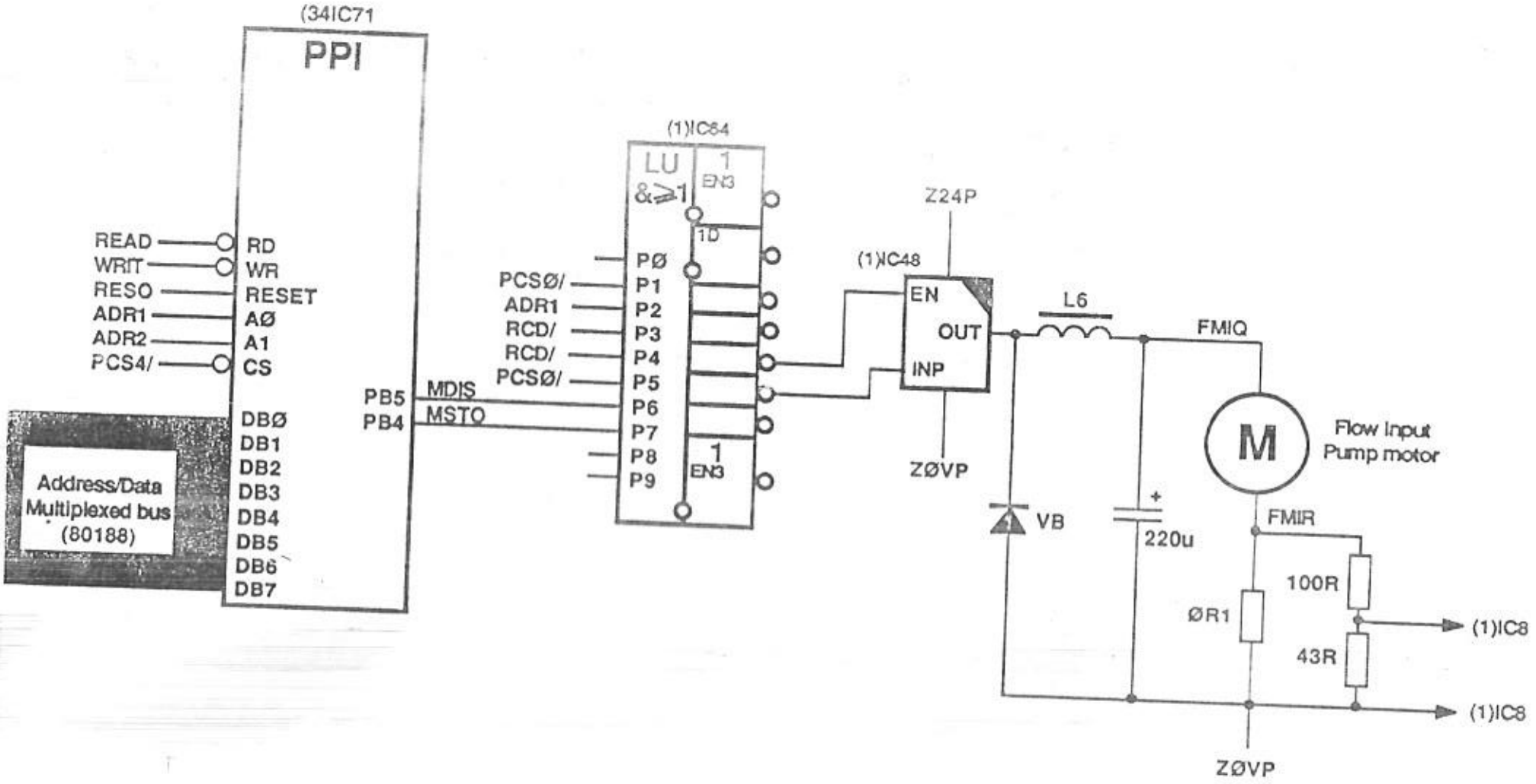
AK 100 FM Flow Output pump circuit

3.O. 06. 1988

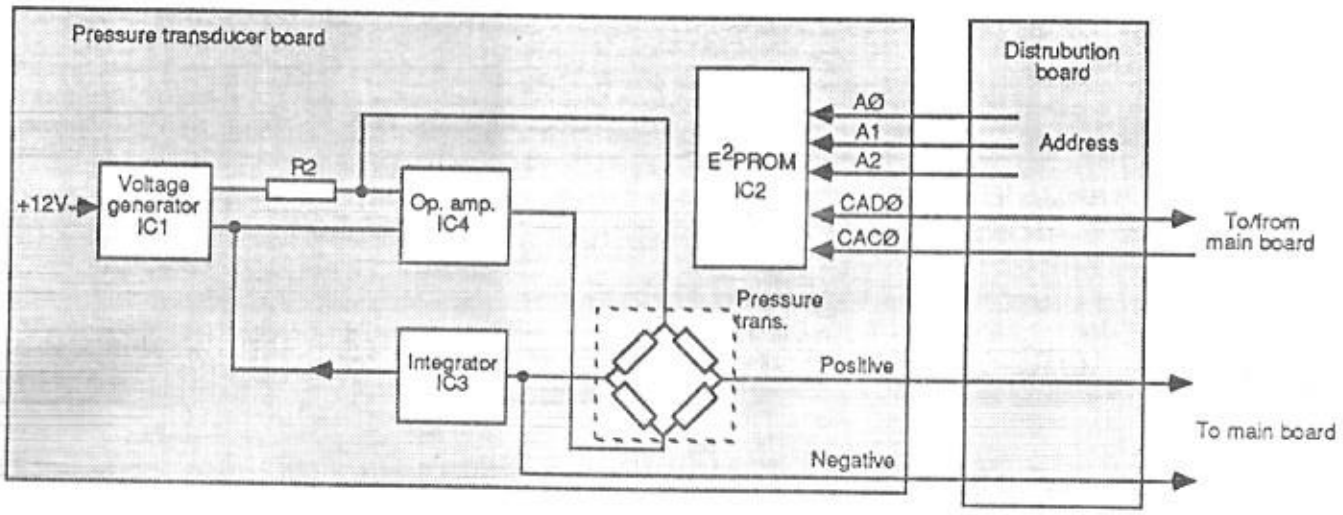


100 FM Flow Input pump circuit

. 06. 1988

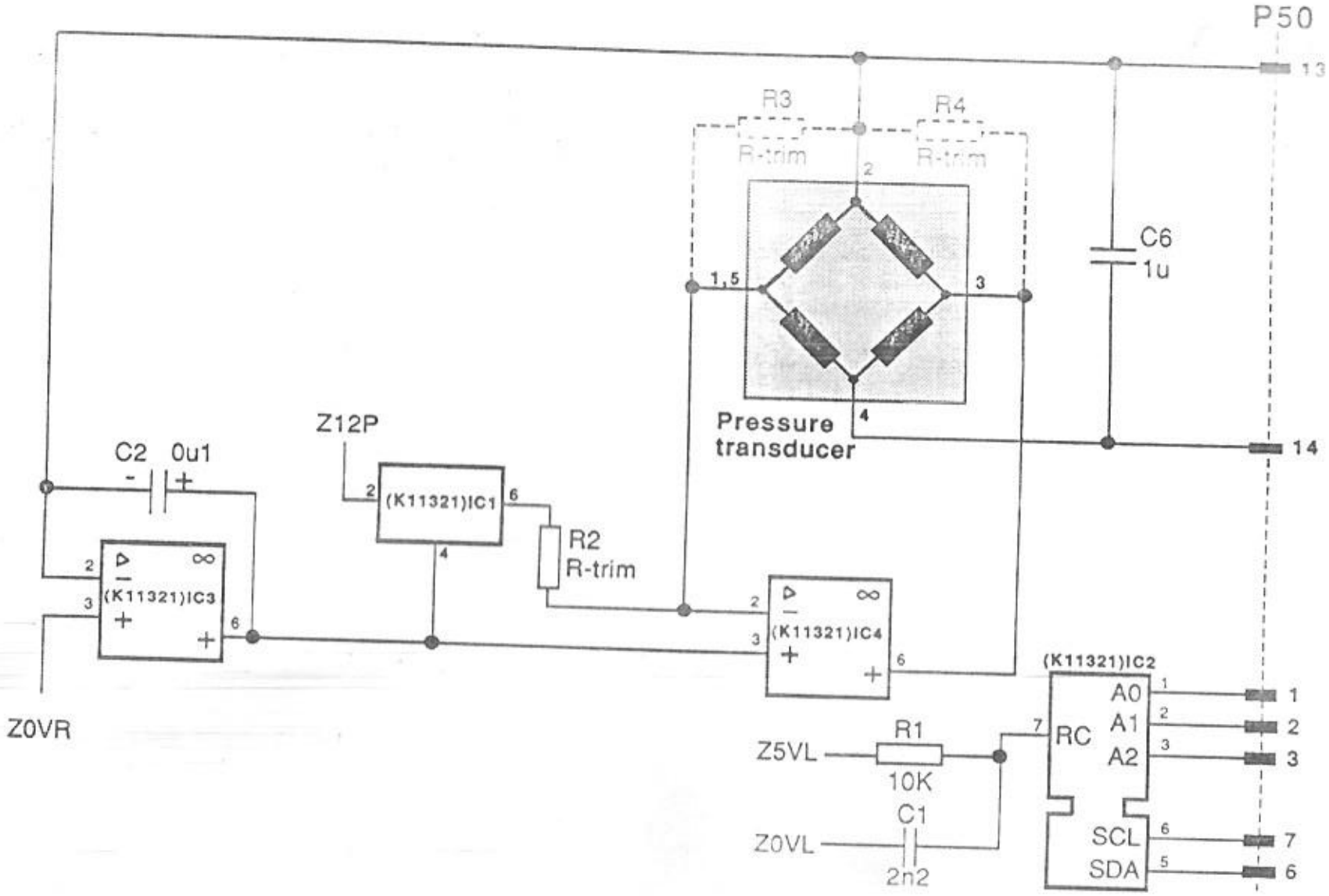


Pressure transducer board

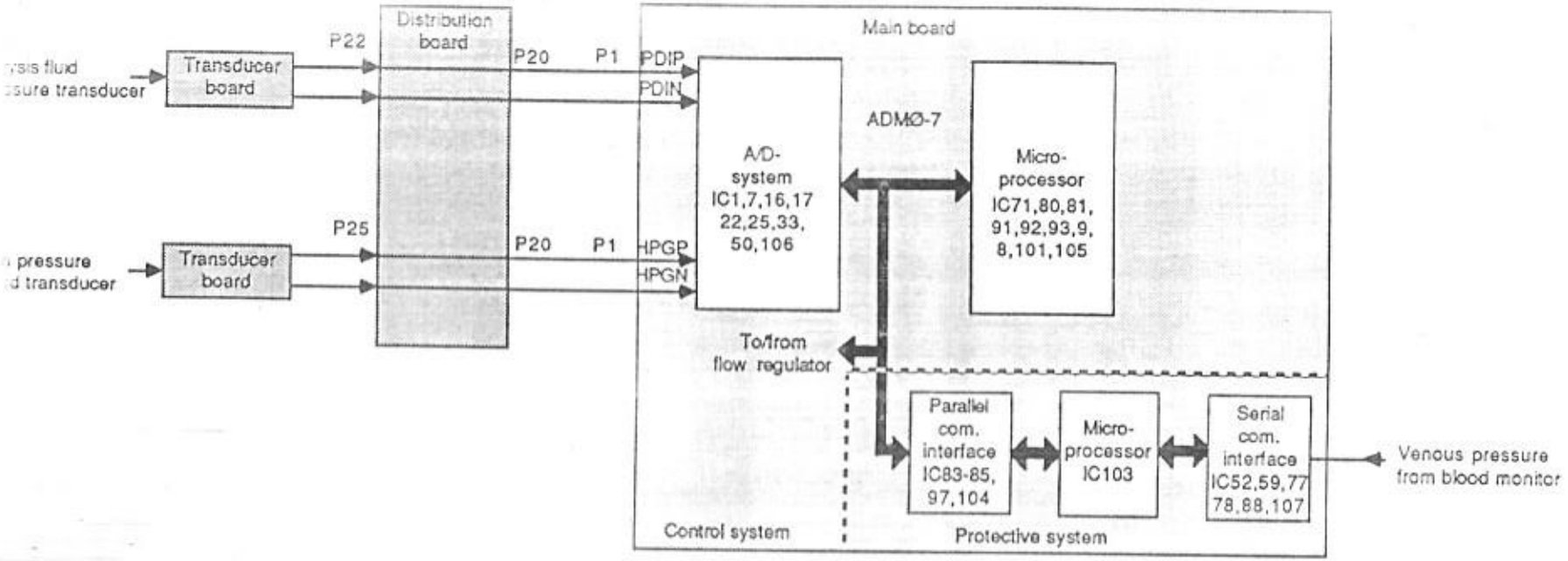


(K 100 BM/FM Pressure transducer board

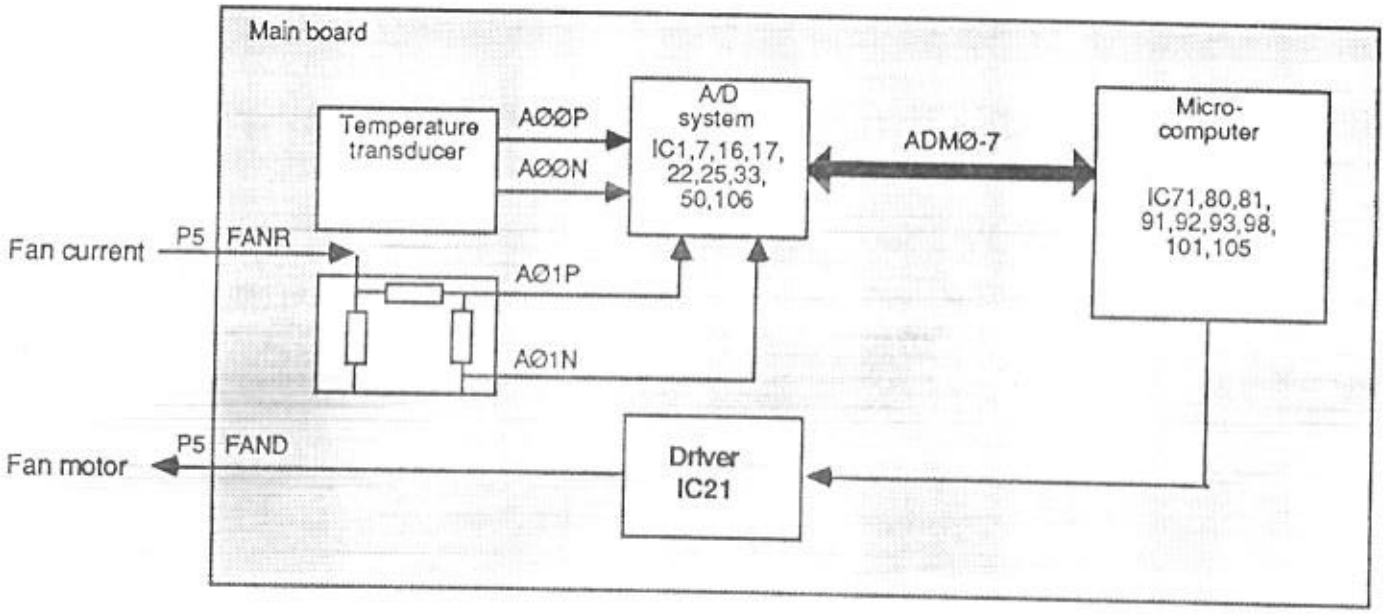
O. 02. 1988



TMP measuring

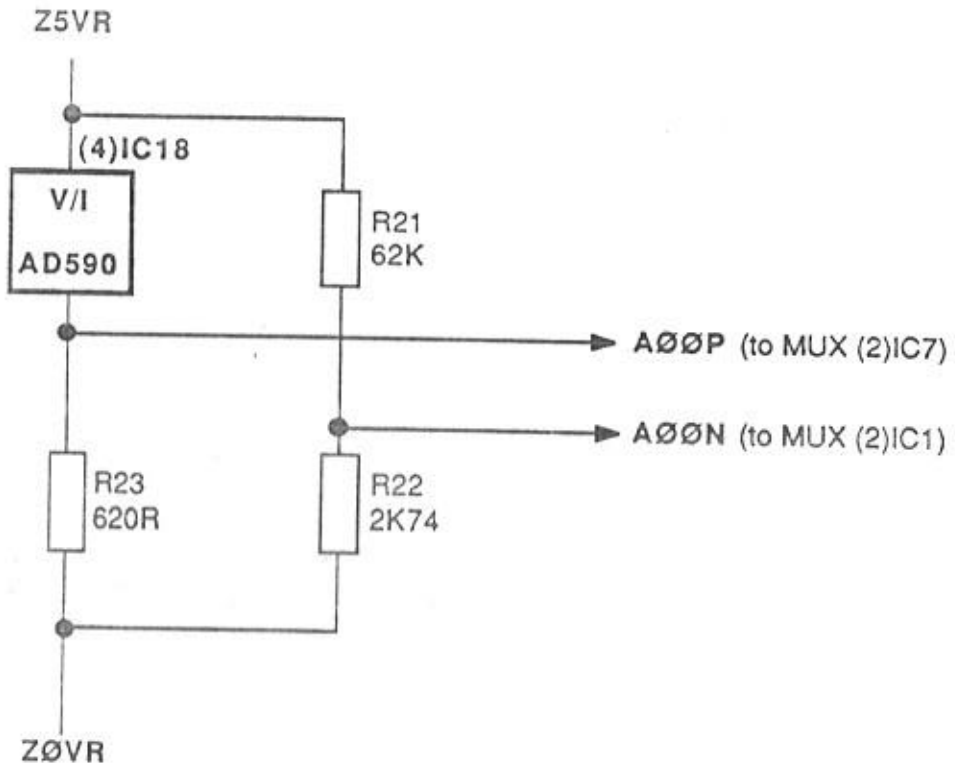


n board temperature
onitoring and regulation



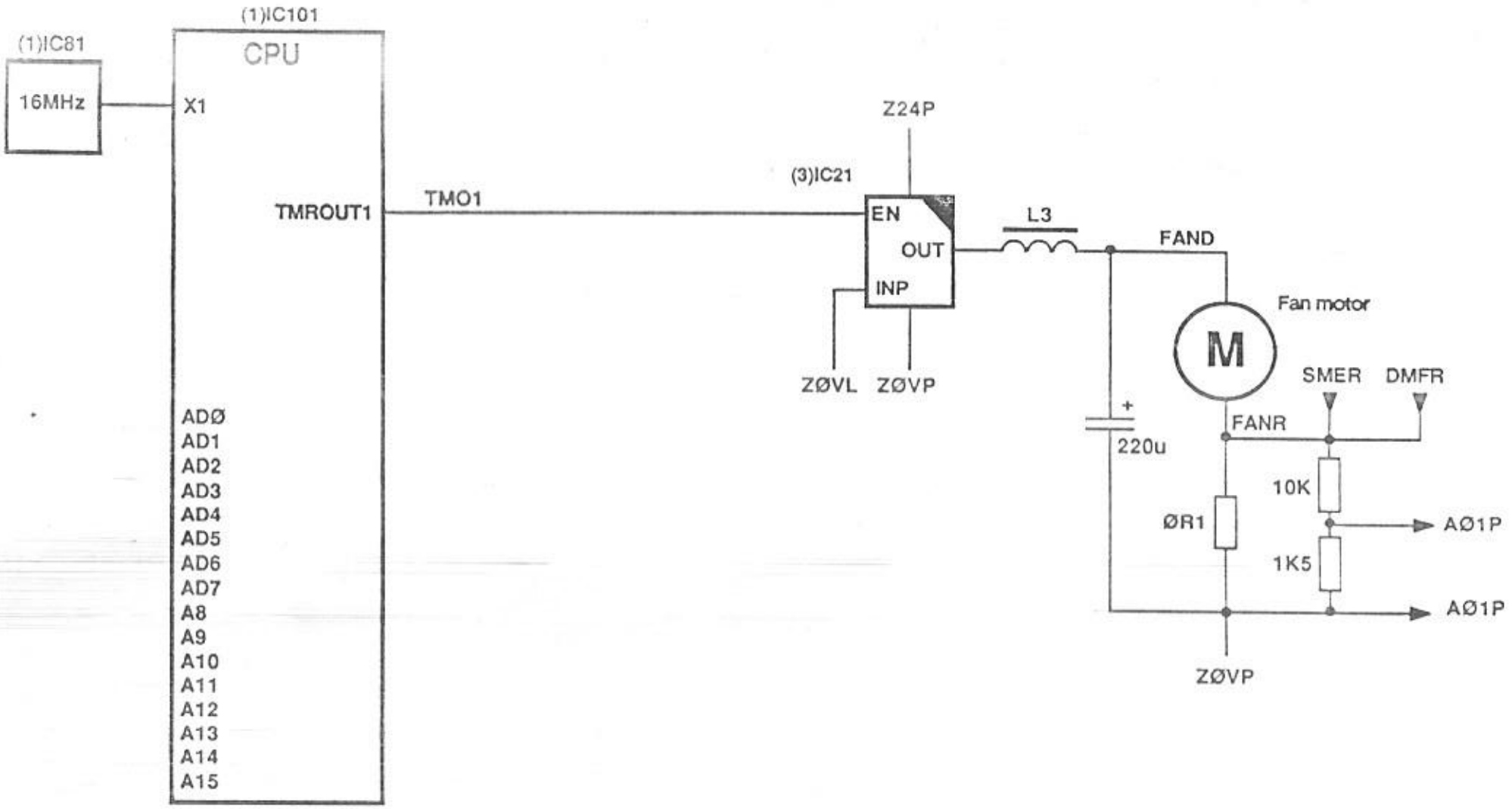
AK 100 FM Main board temperature circuit.

B.O. 02. 1988

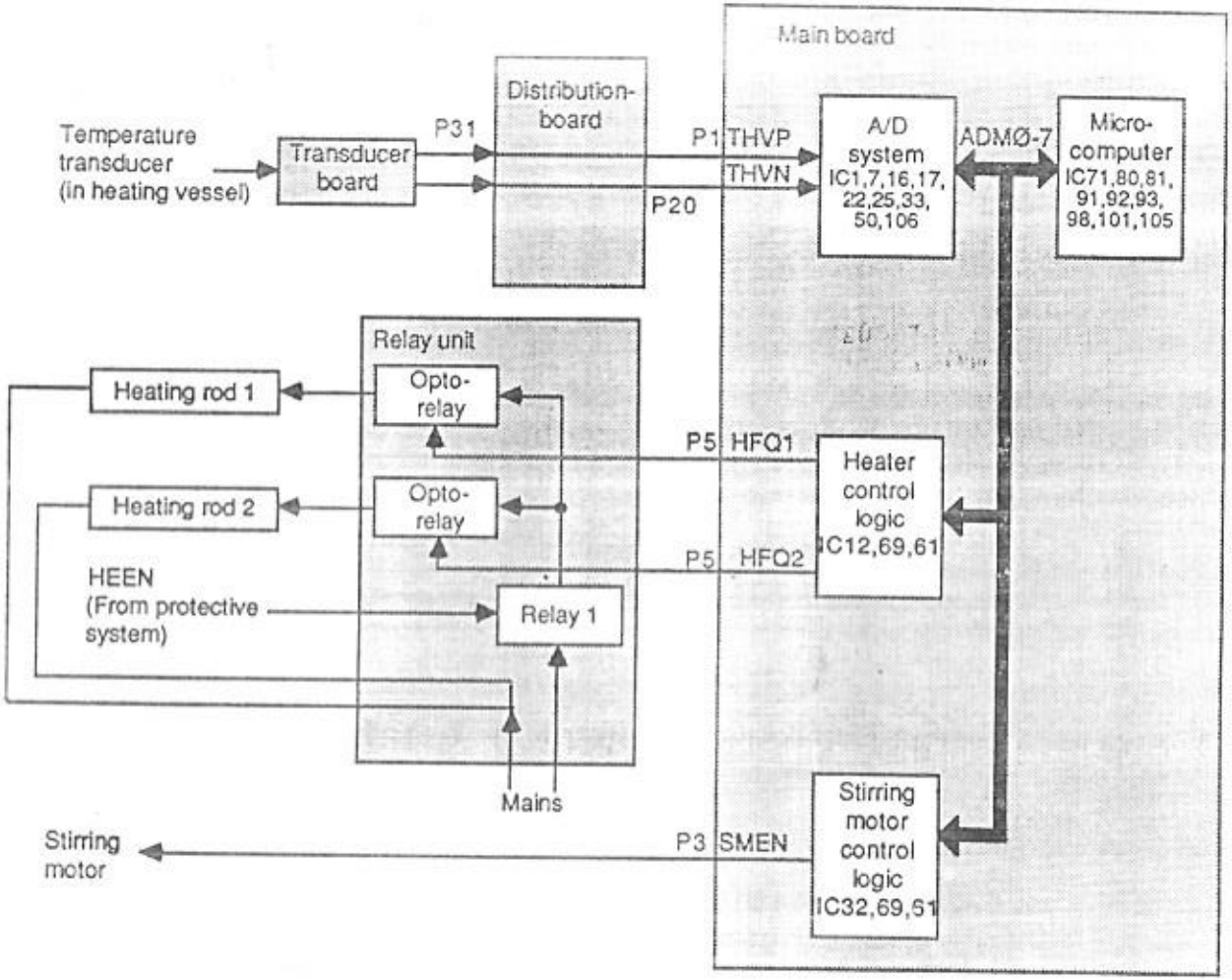


10C FM Fan motor circuit

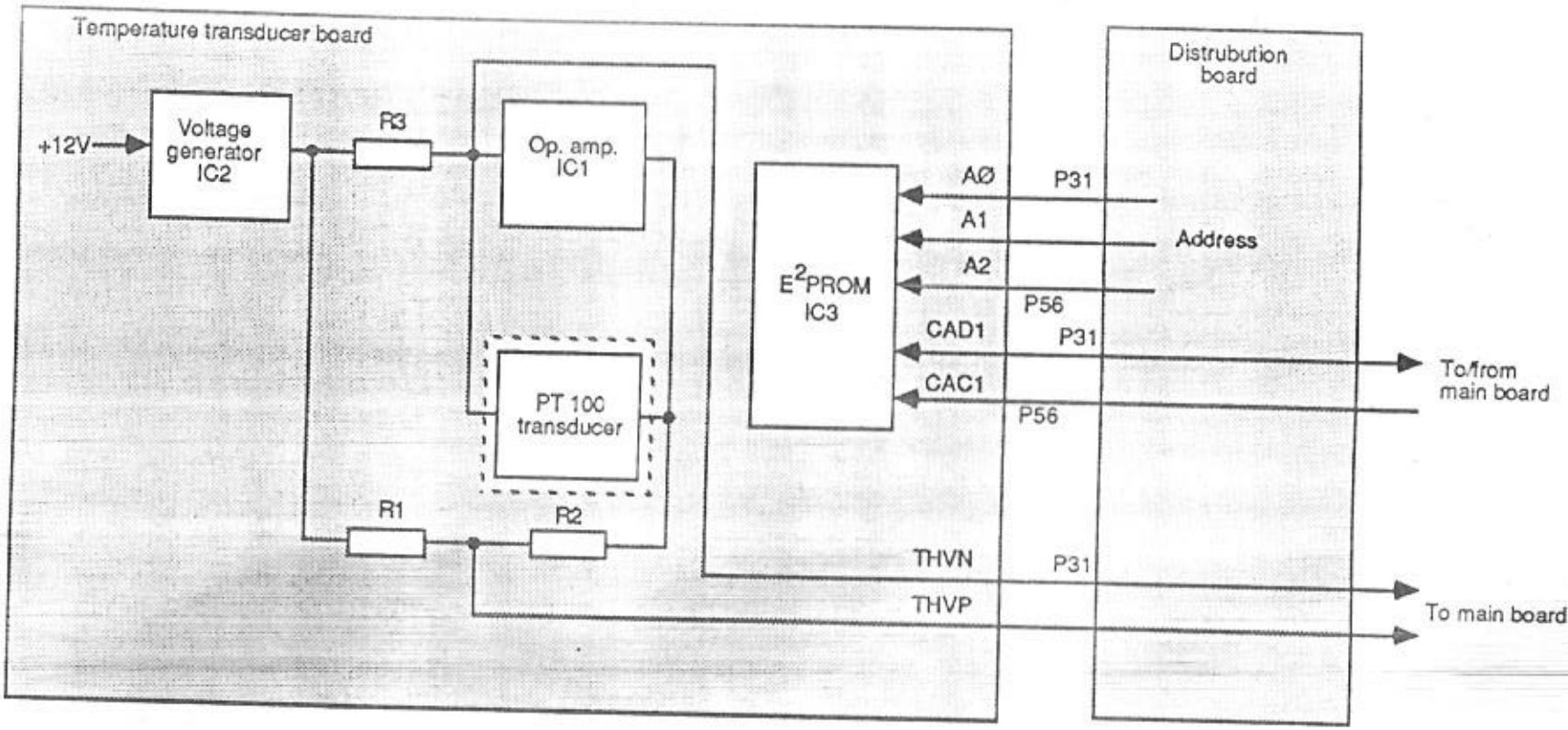
06. 1988



Temperature monitoring and regulation

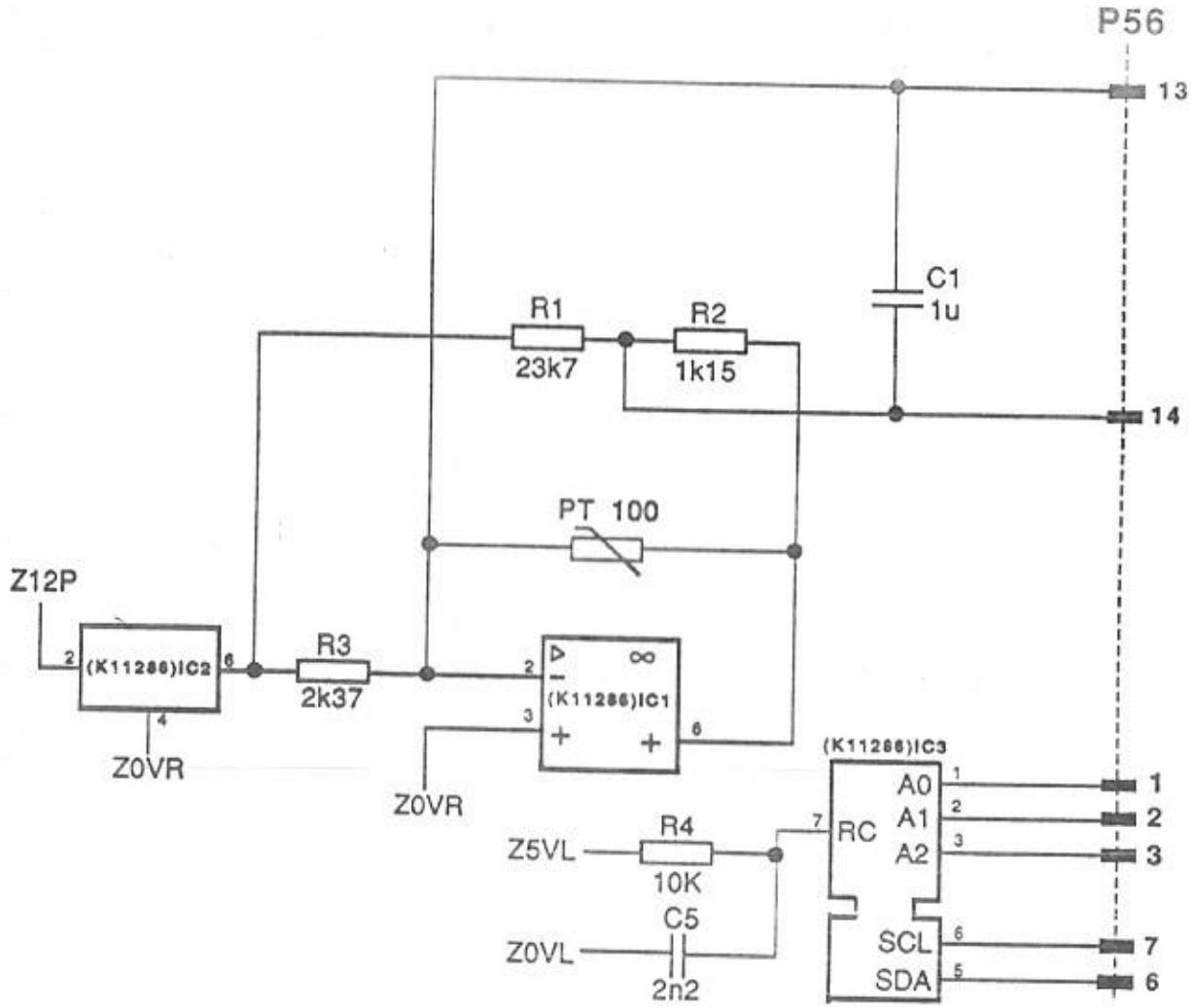


Temperature transducer board



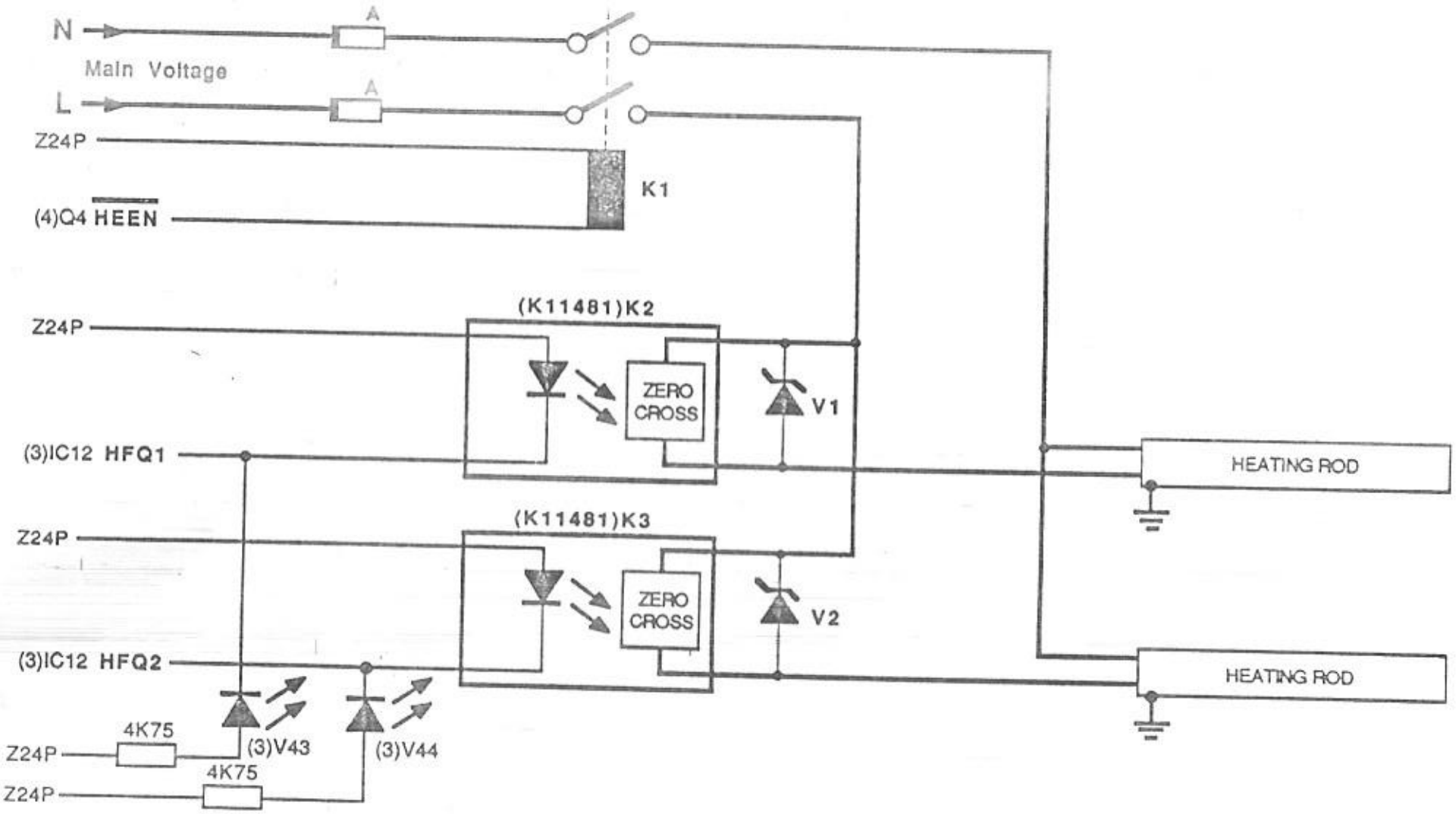
AK 100 Heating vessel temperature transducer board

B.O. 02. 1988



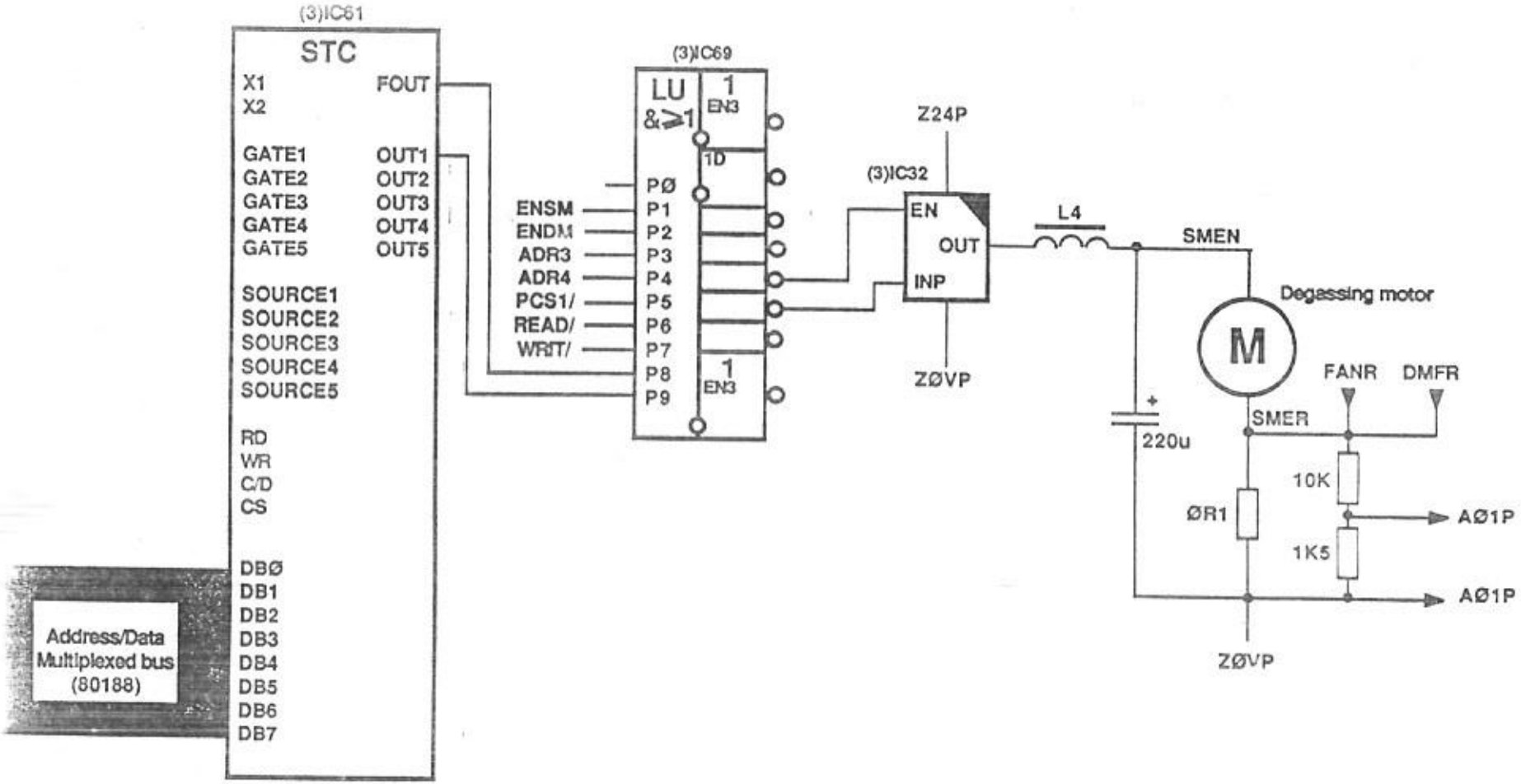
AK 100 FM Heating element control

B.O. 02. 1988



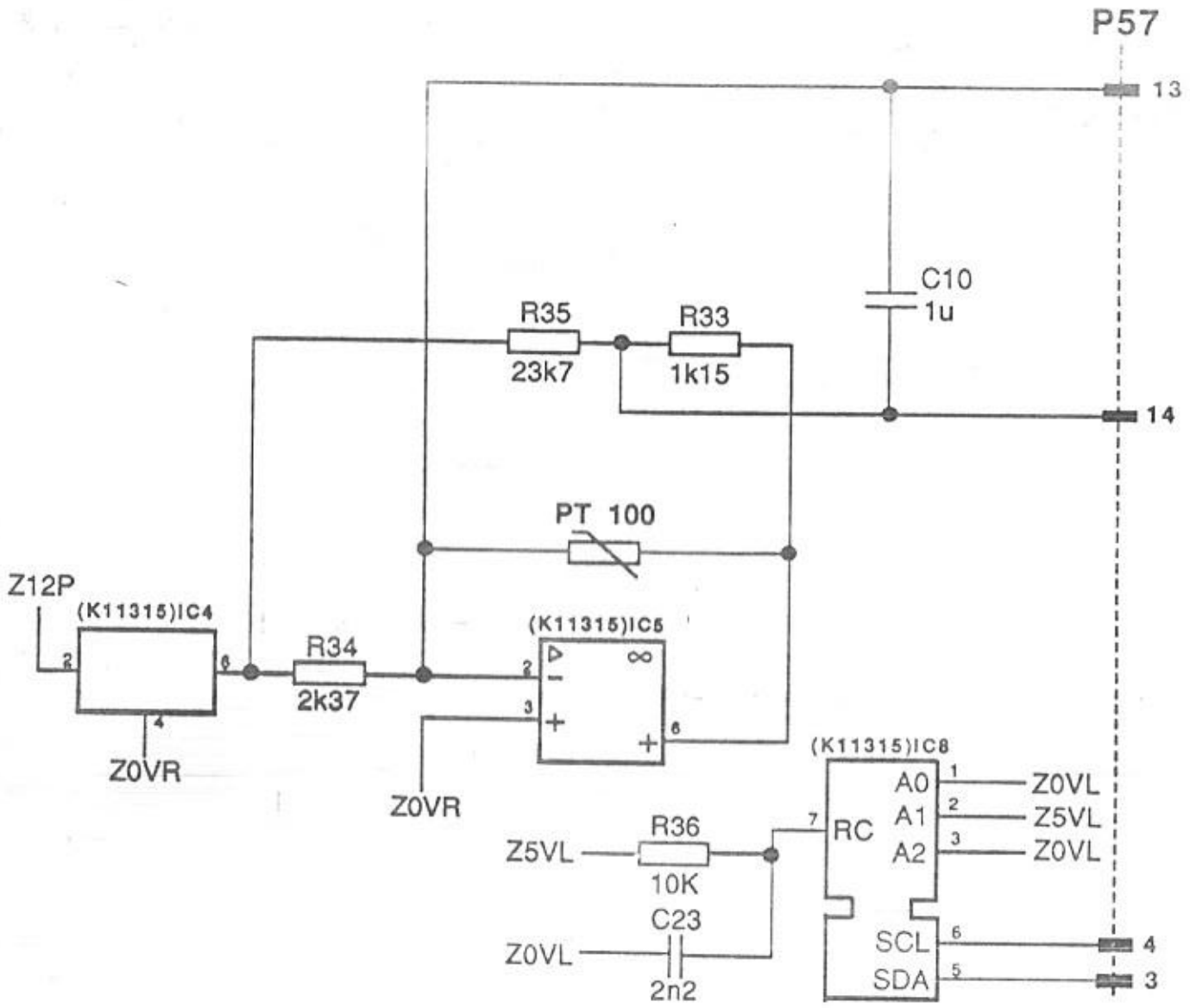
AK 100 FM Water Vessel Stirring pump circuit

.O. 06. 1988



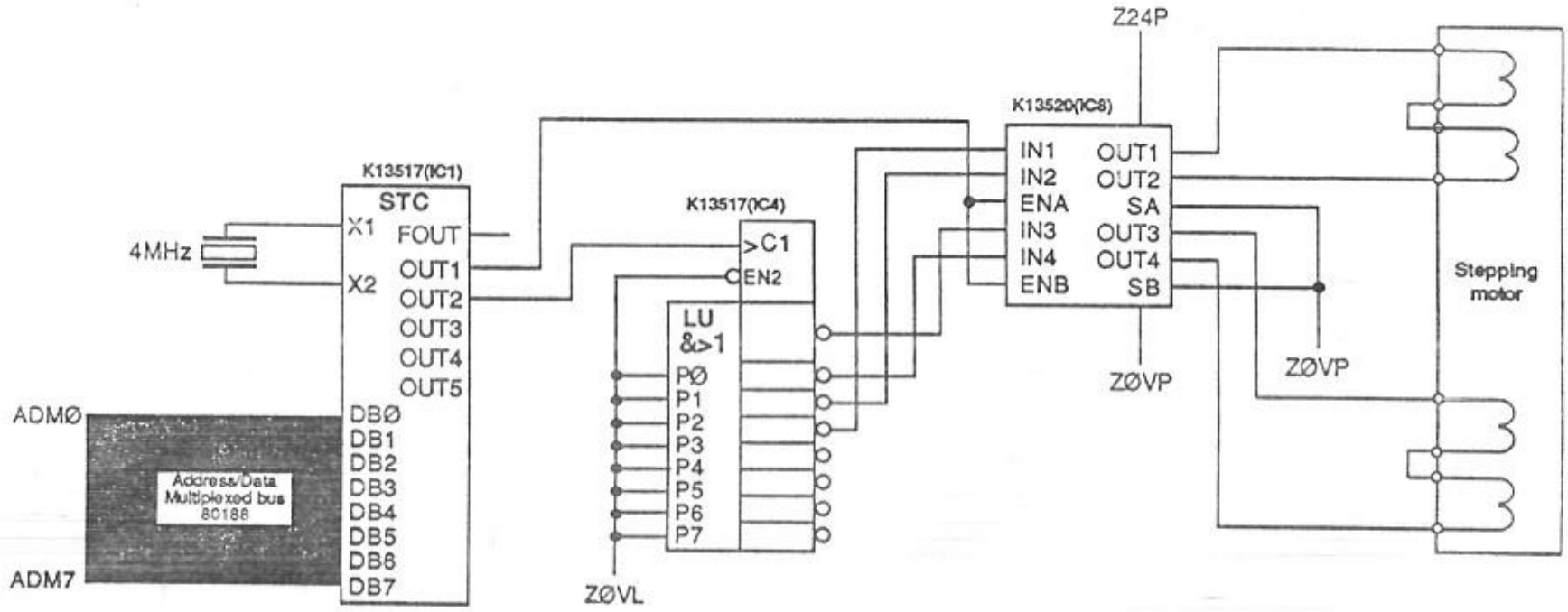
AK 10[illegible]FM Temperature transducer circuit (cond. board #2)

B.O. 04. 1987



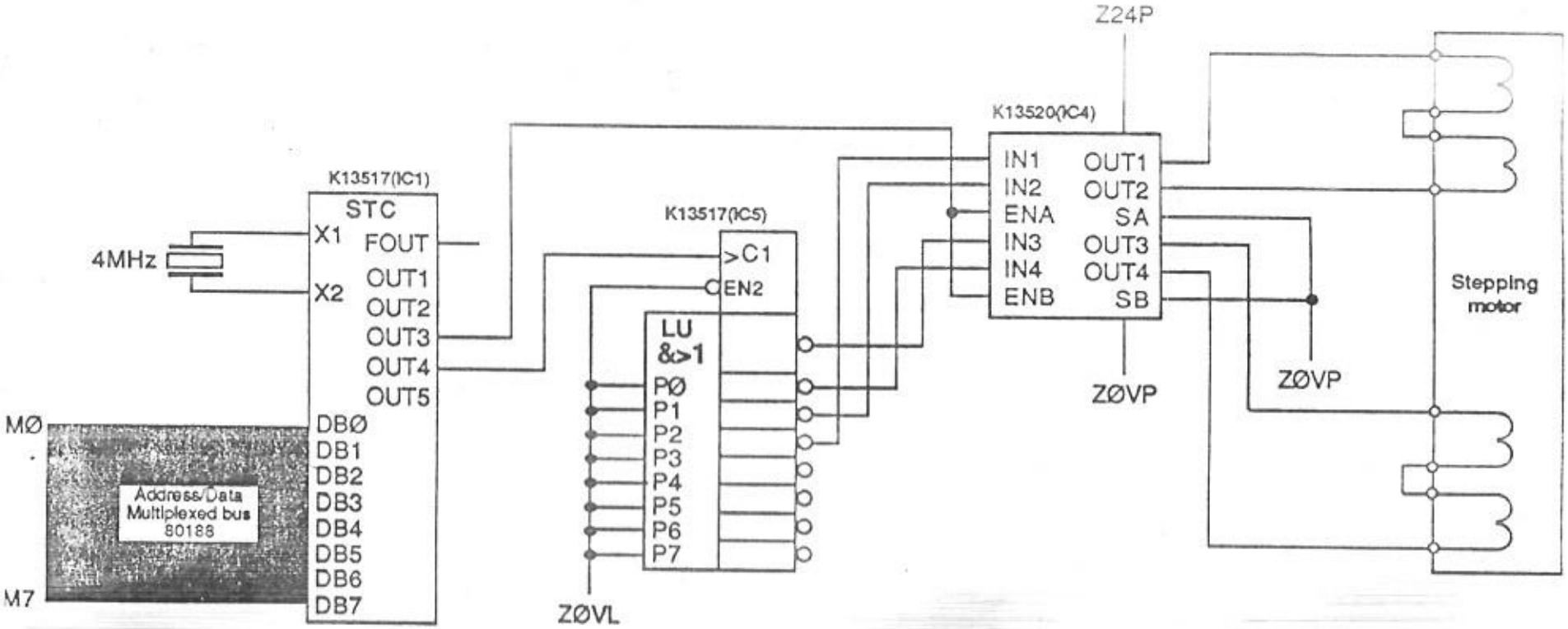
AK 100 FM Proportioning pump 1

B.O. 05. 1988

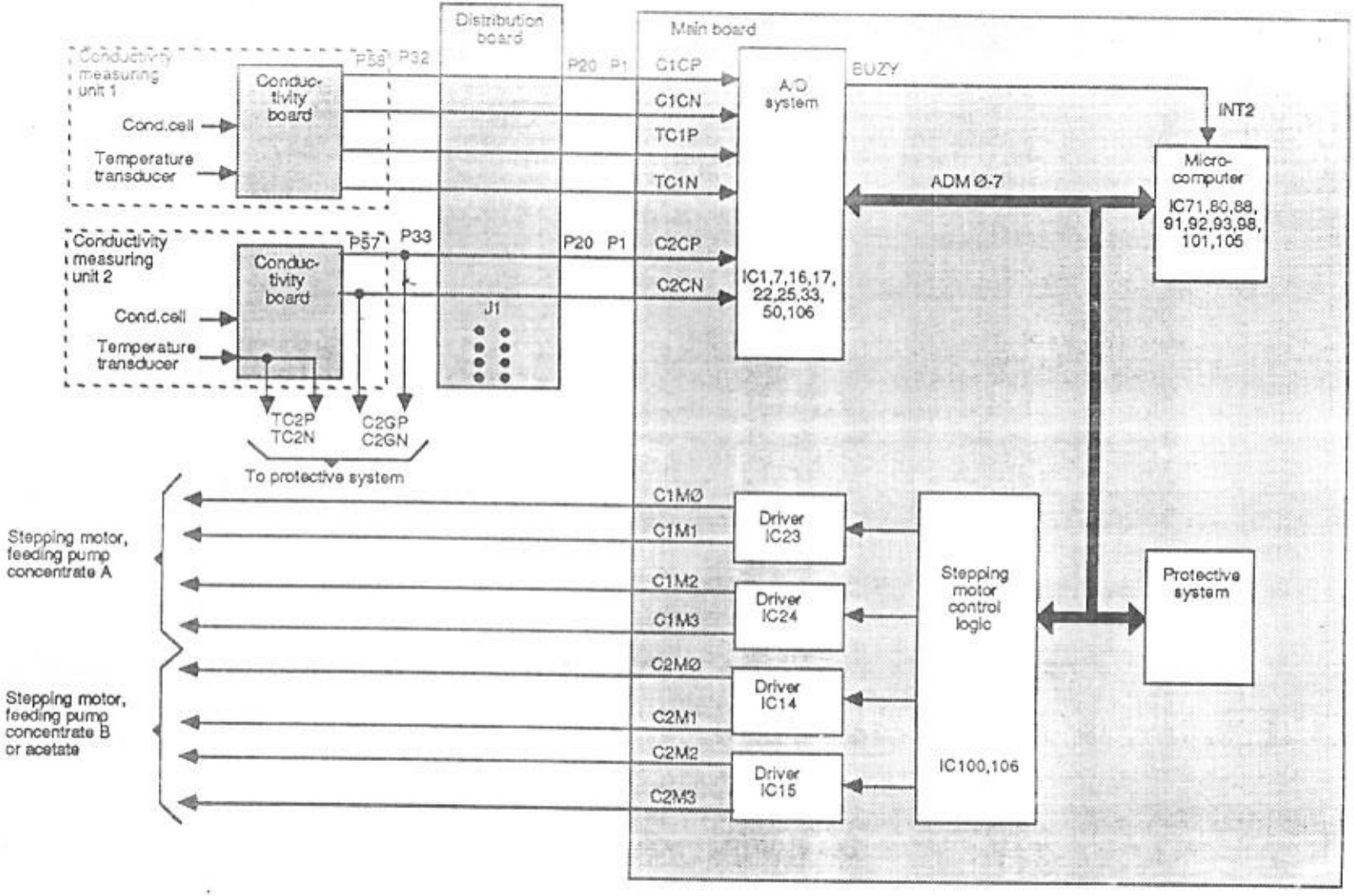


< 100 FM Proportioning pump 2

05. 1988



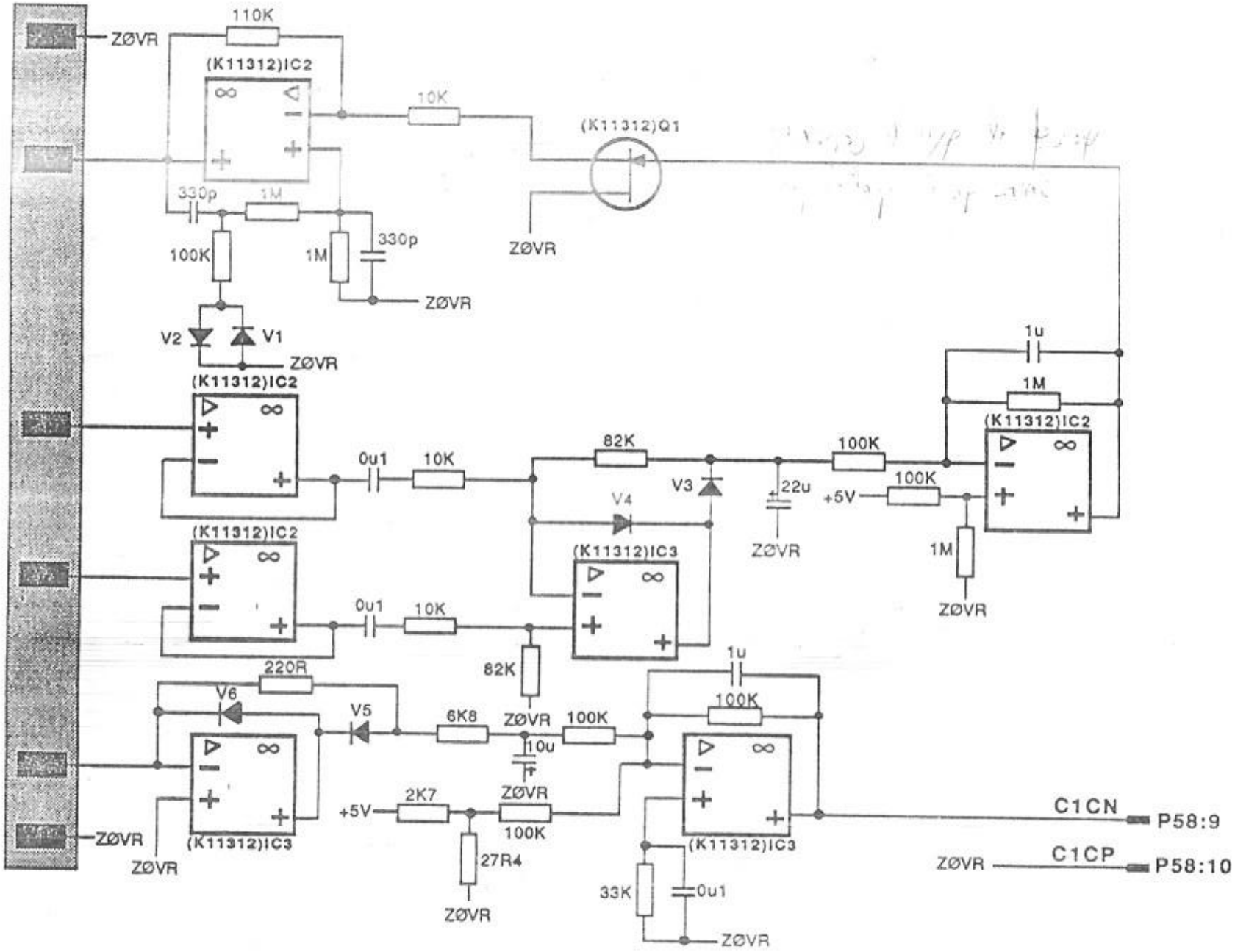
Conductivity monitoring and regulation (Bicarb. system)



A.K 100 Conductivity board #1

3.O. 02. 1988

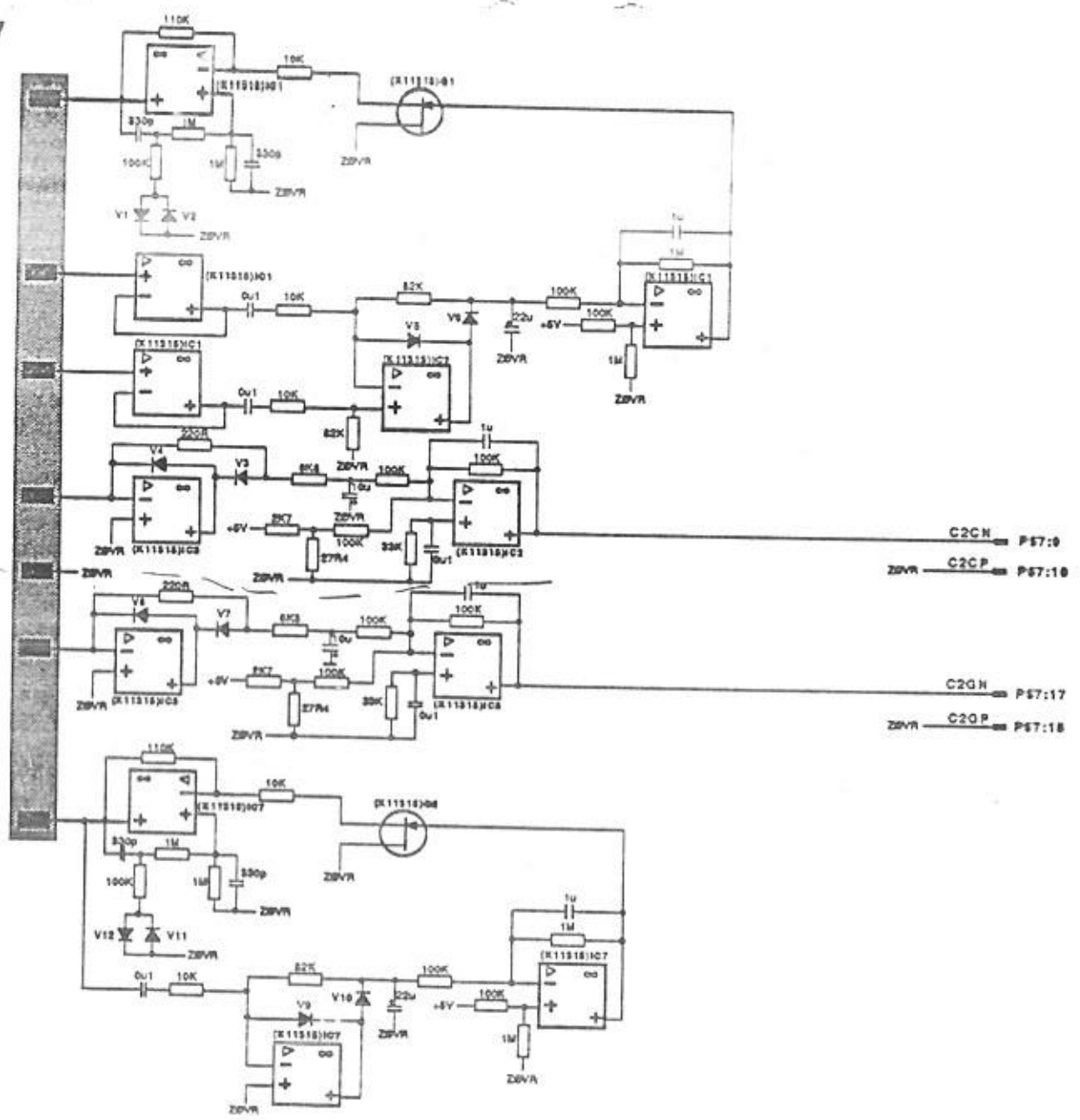
nductivity
cell



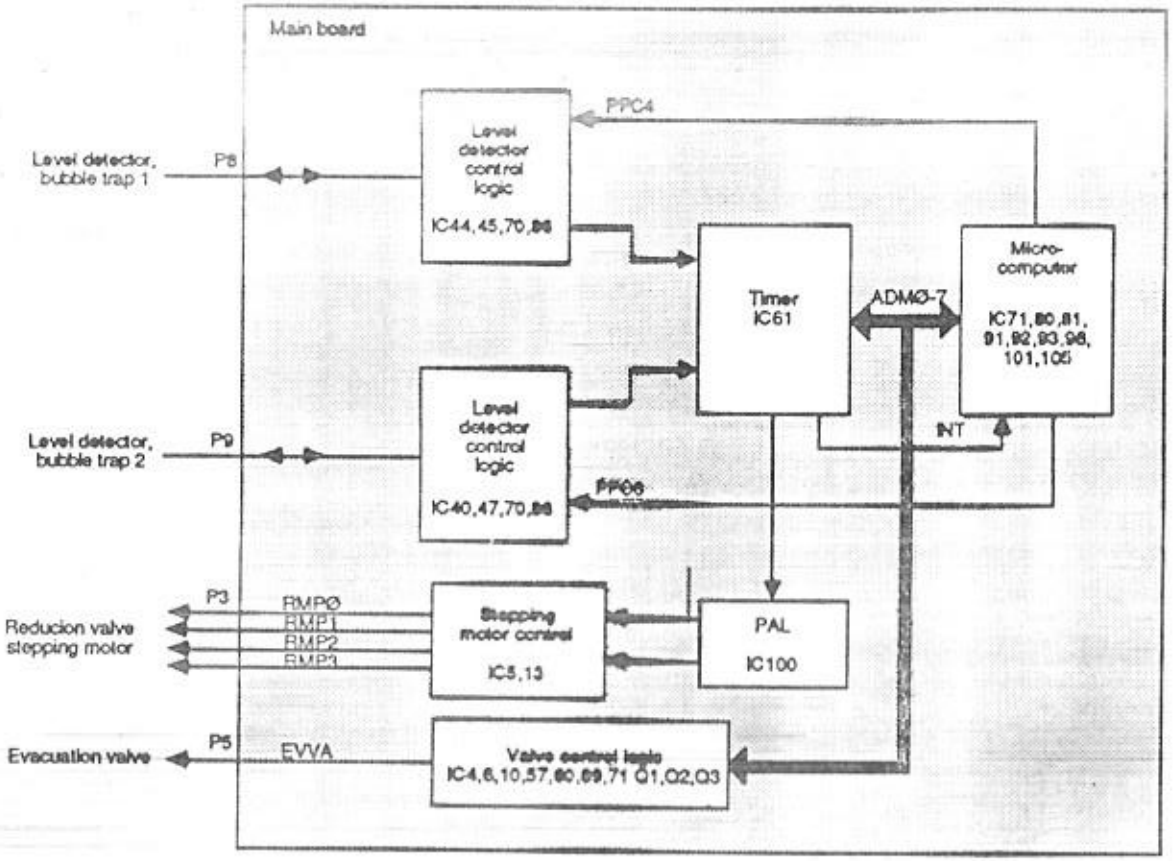
AK 100 Conductivity
Board #2

...O. 02. 1988

Conductivity cell

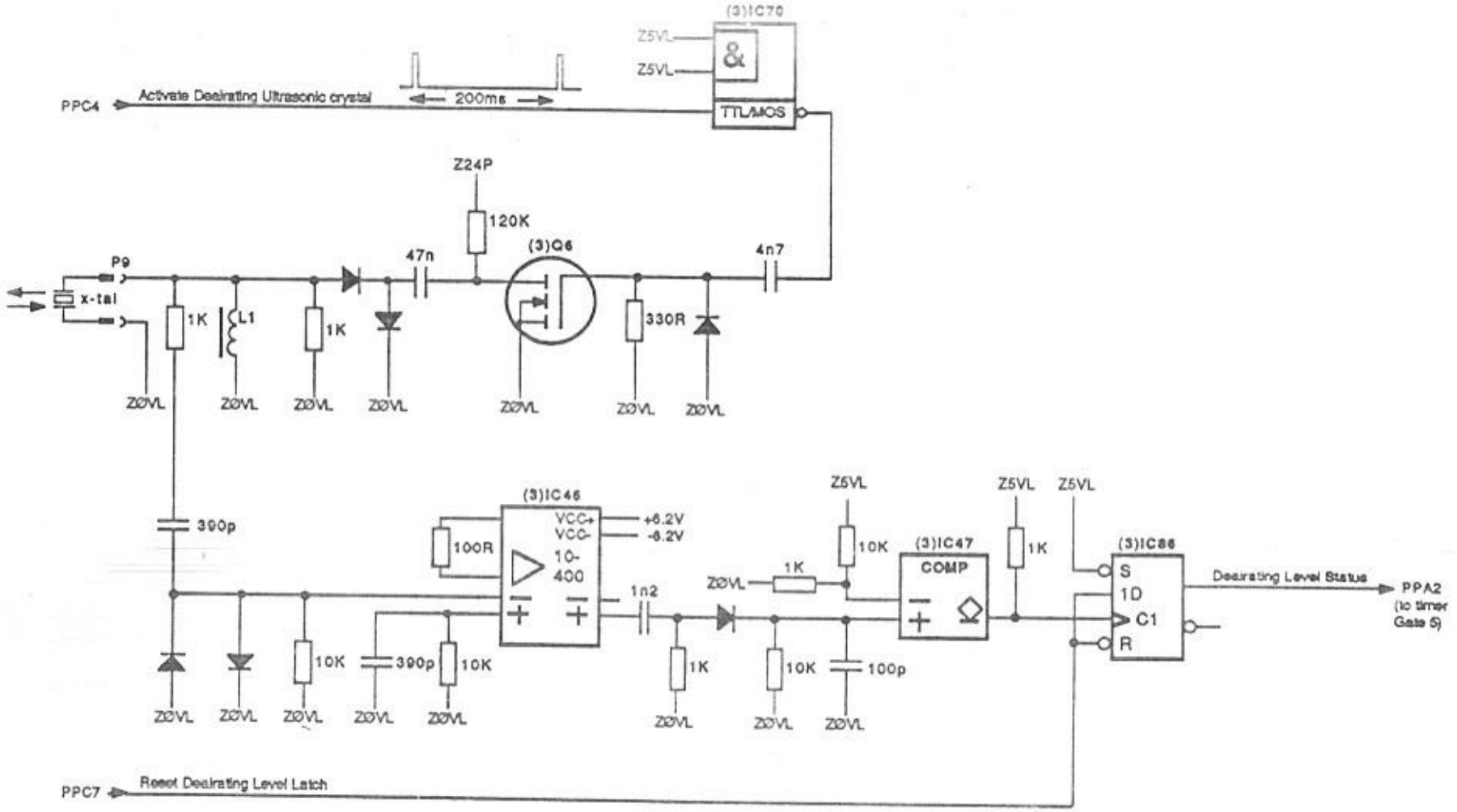


ıbble trap monitoring
d regulation



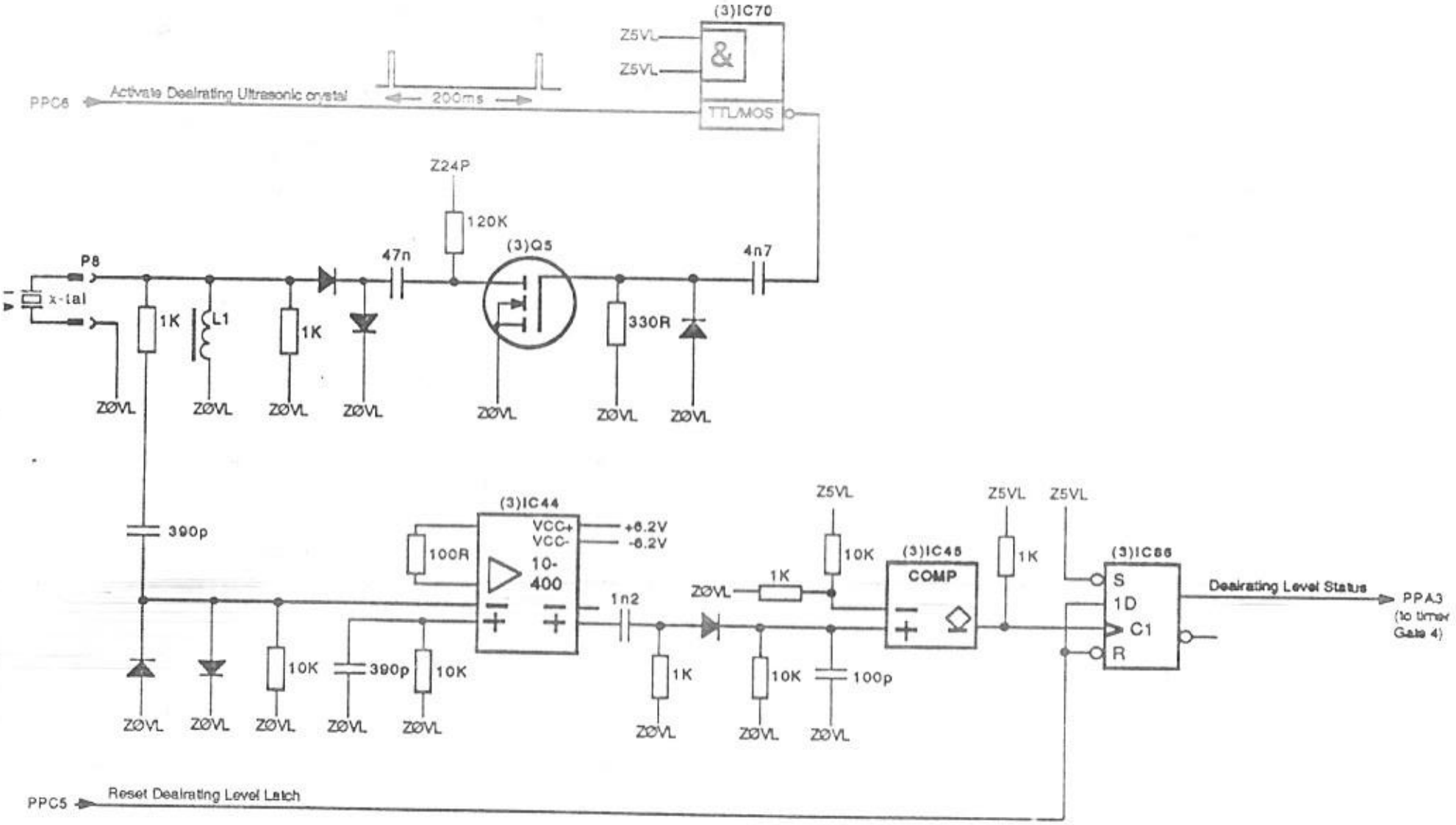
AK 100 FM Level detector circuit

B.O. 02. 1988



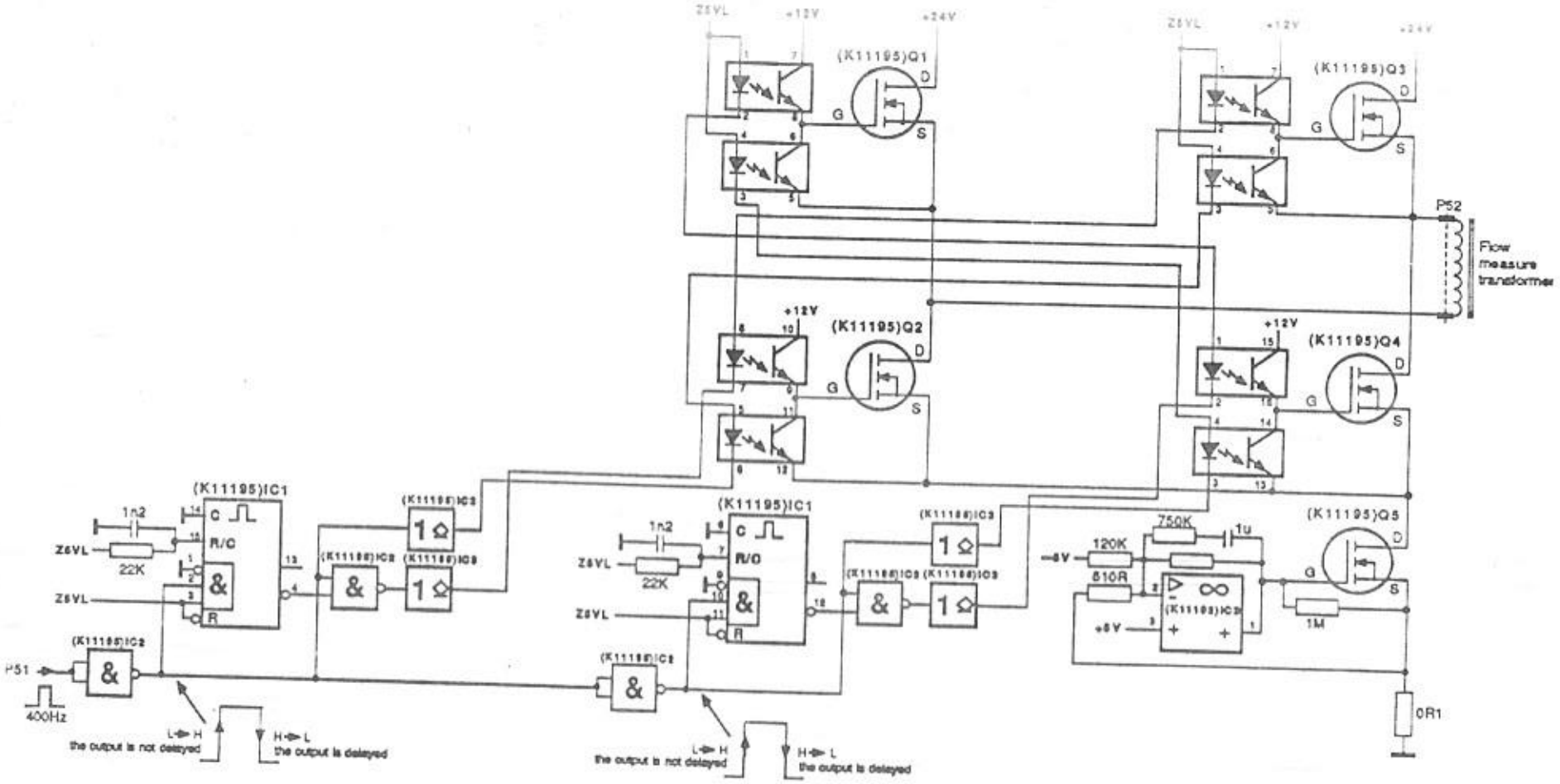
,K 100 FM Level detector circuit

O. 01. 1988

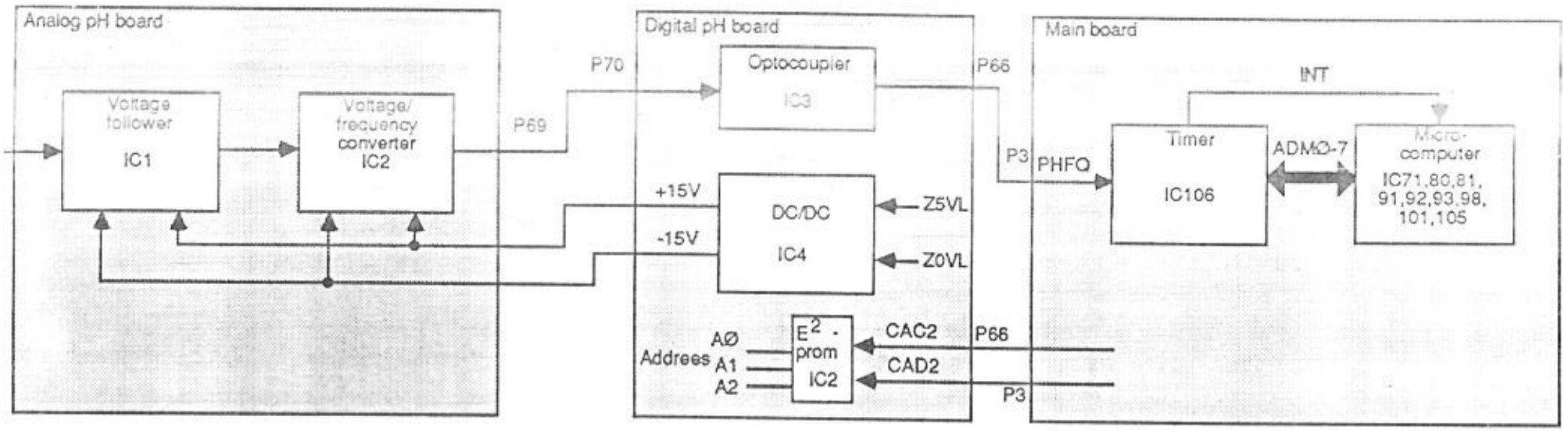


AK 100 UFM driver circuit

B.O. 02. 1988

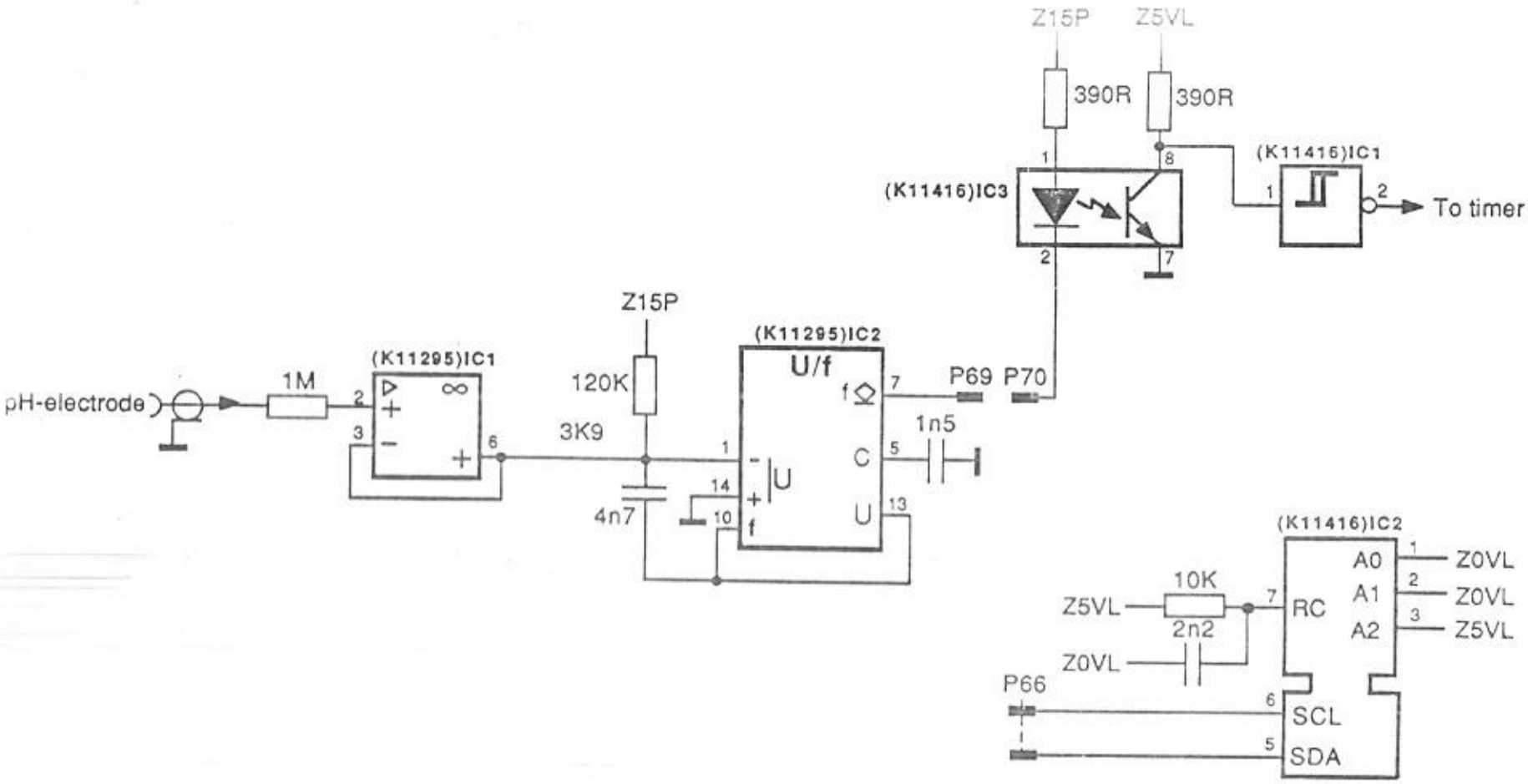


pH measuring (optional)

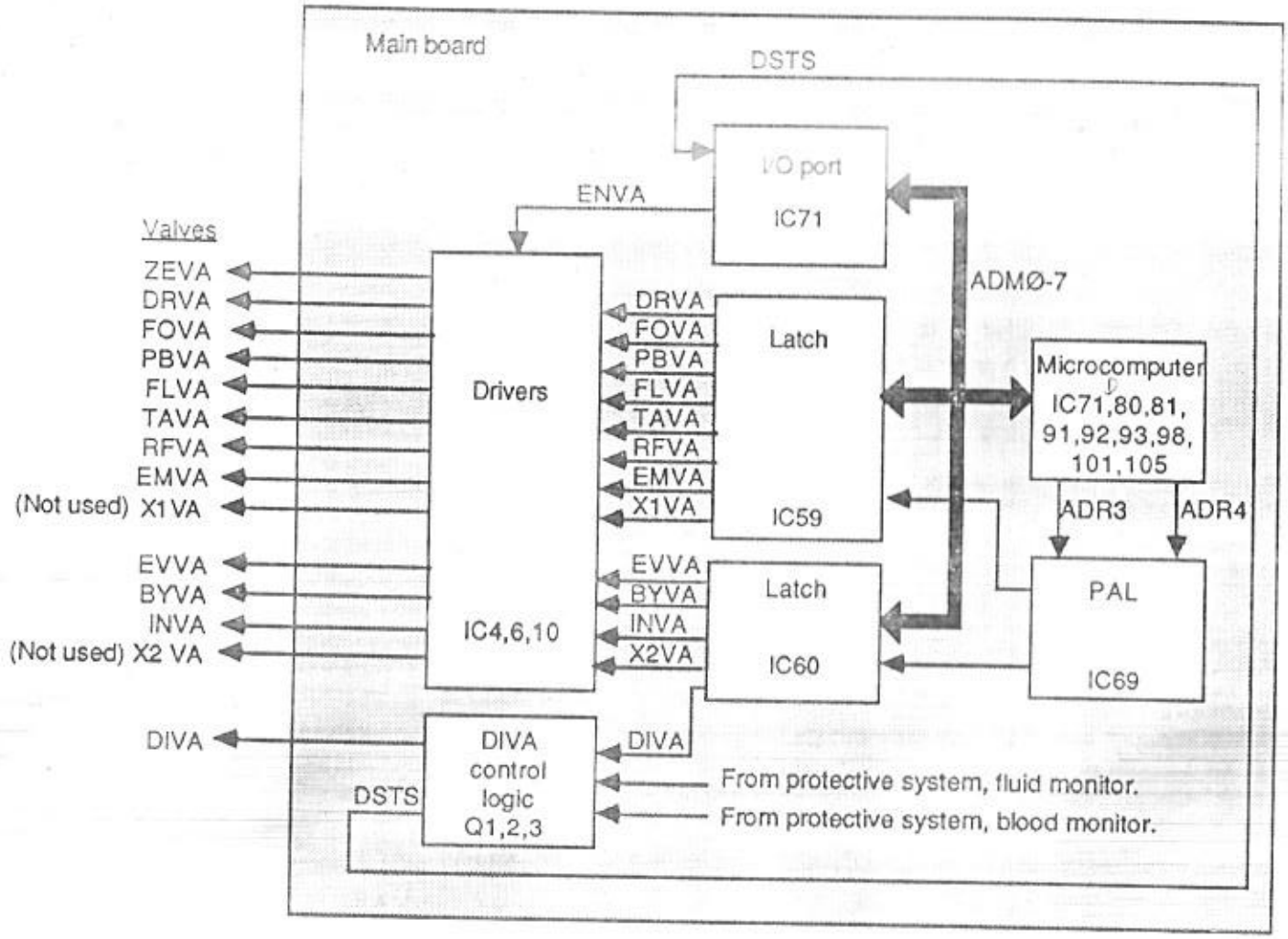


AK 100 FM pH measuring circuit

B.O. 02. 1988

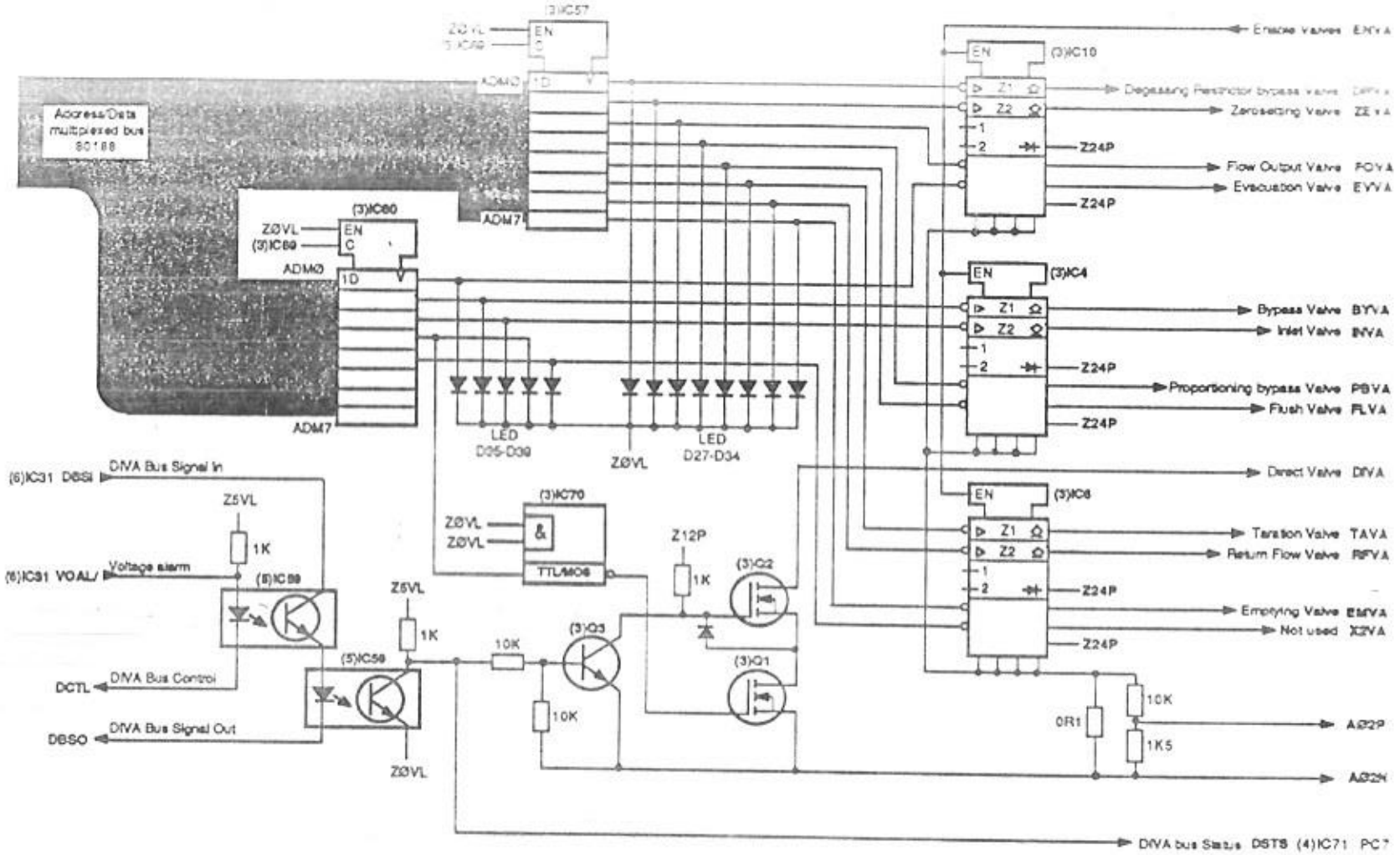


'alve control logic

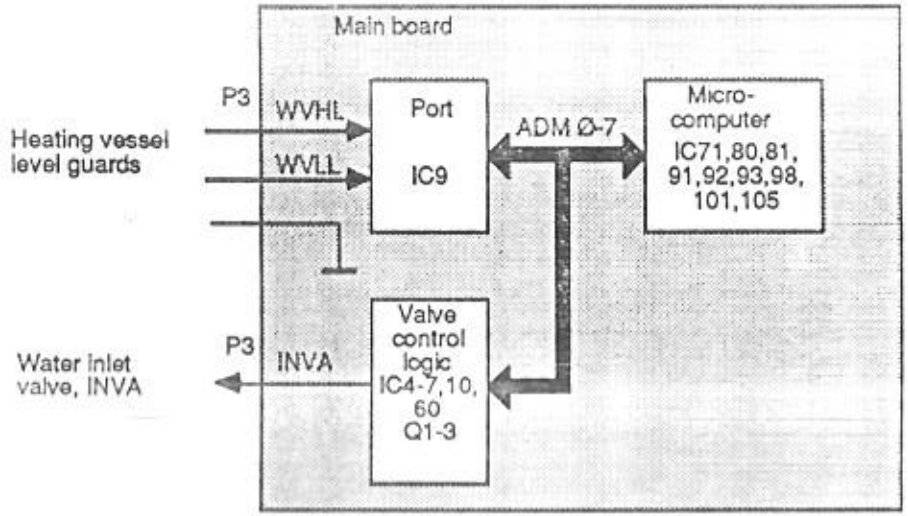


AK 100 FM Valve Control

B.O. 06. 1988

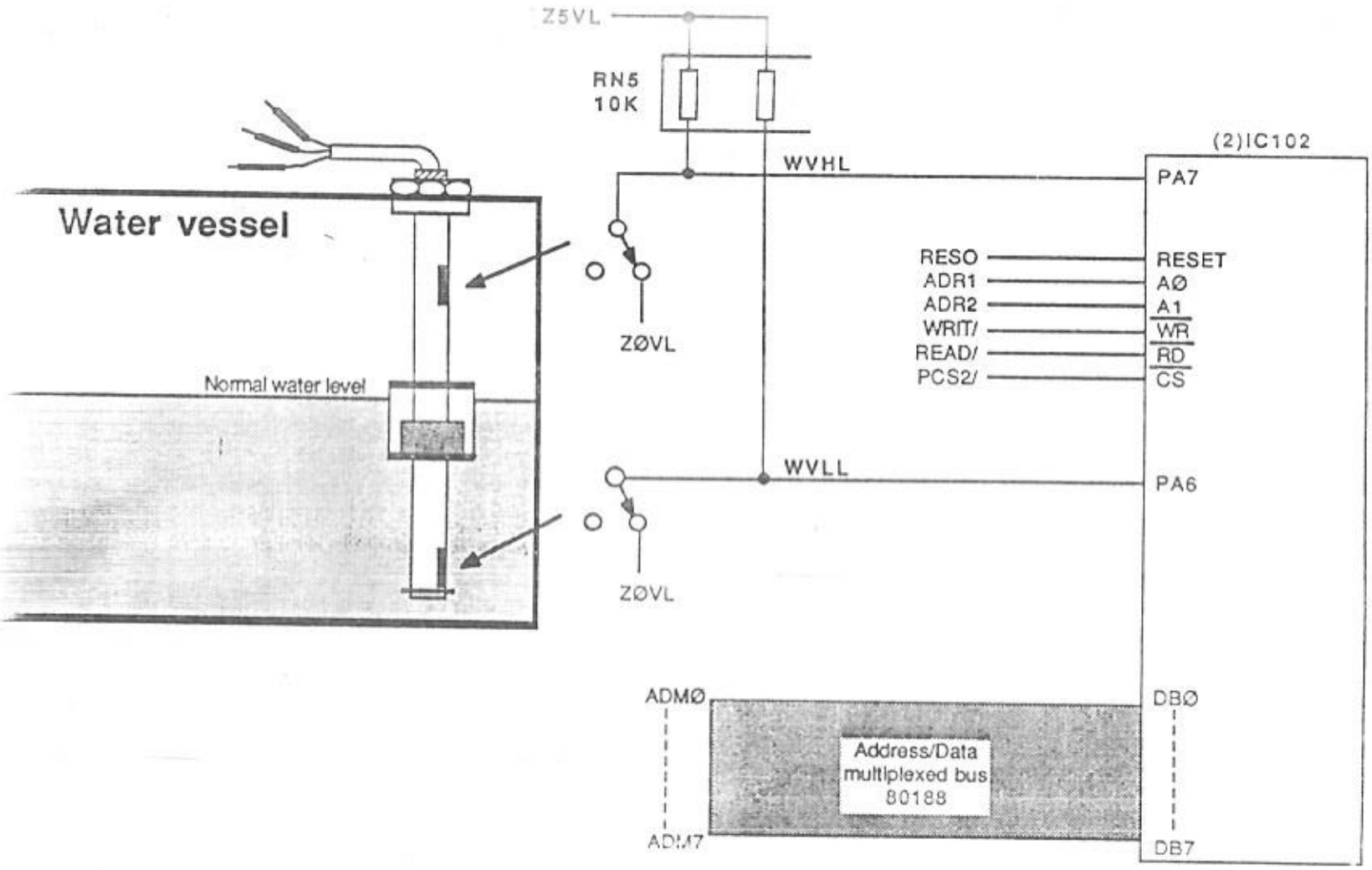


ater level monitoring
nd control

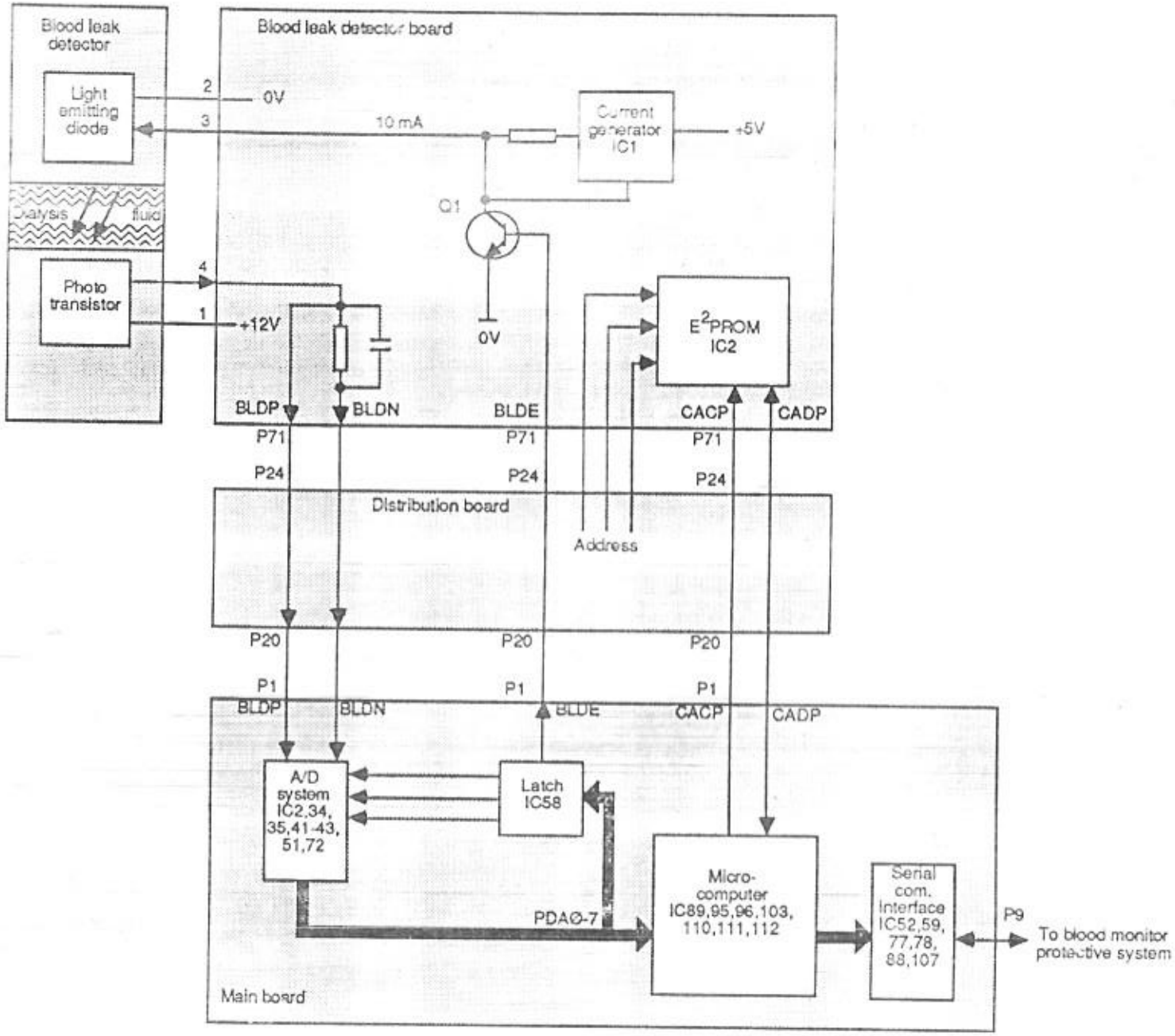


AK 100 FM Water level monitoring

10. 03. 1988

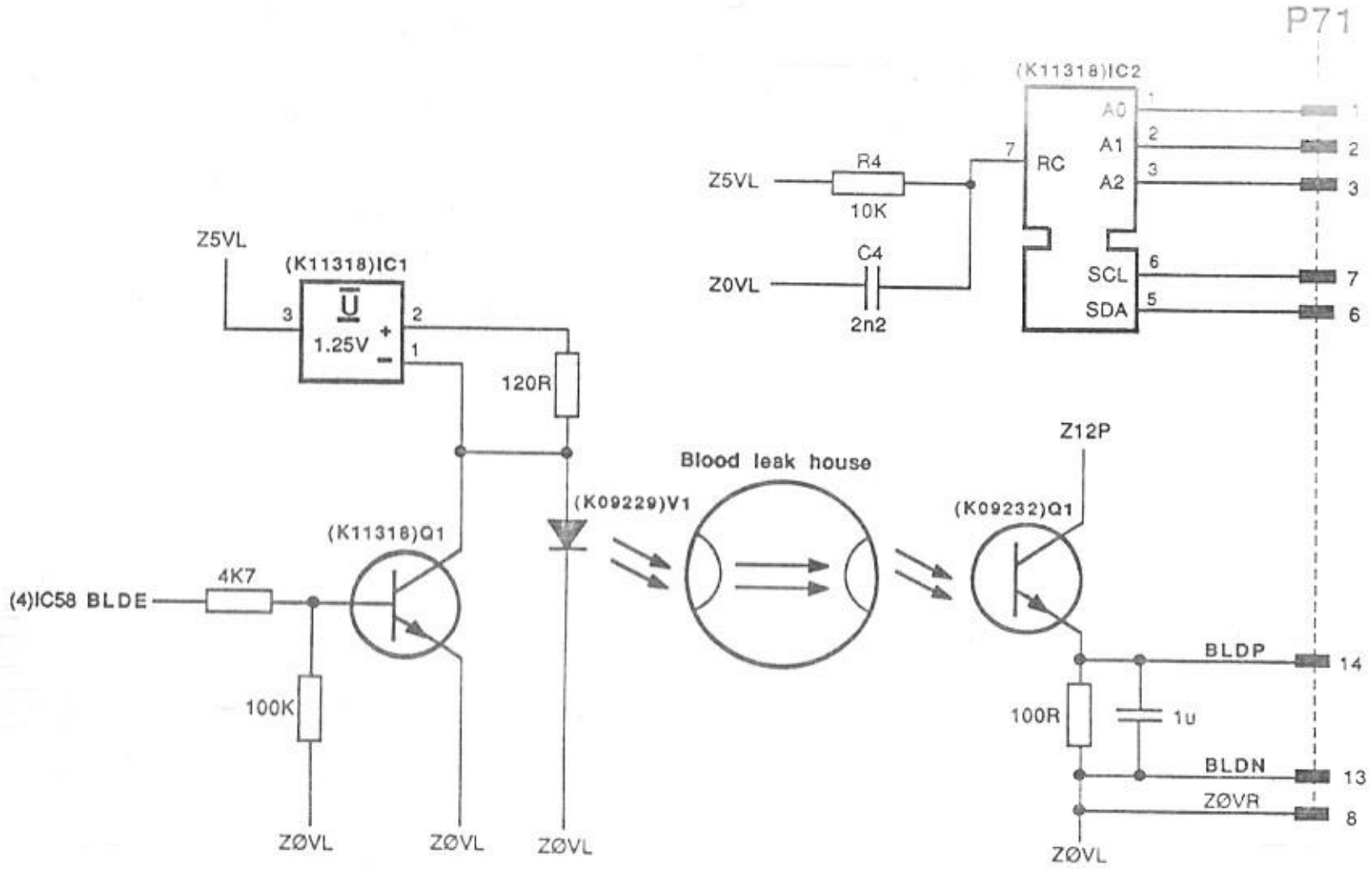


Blood leak detection



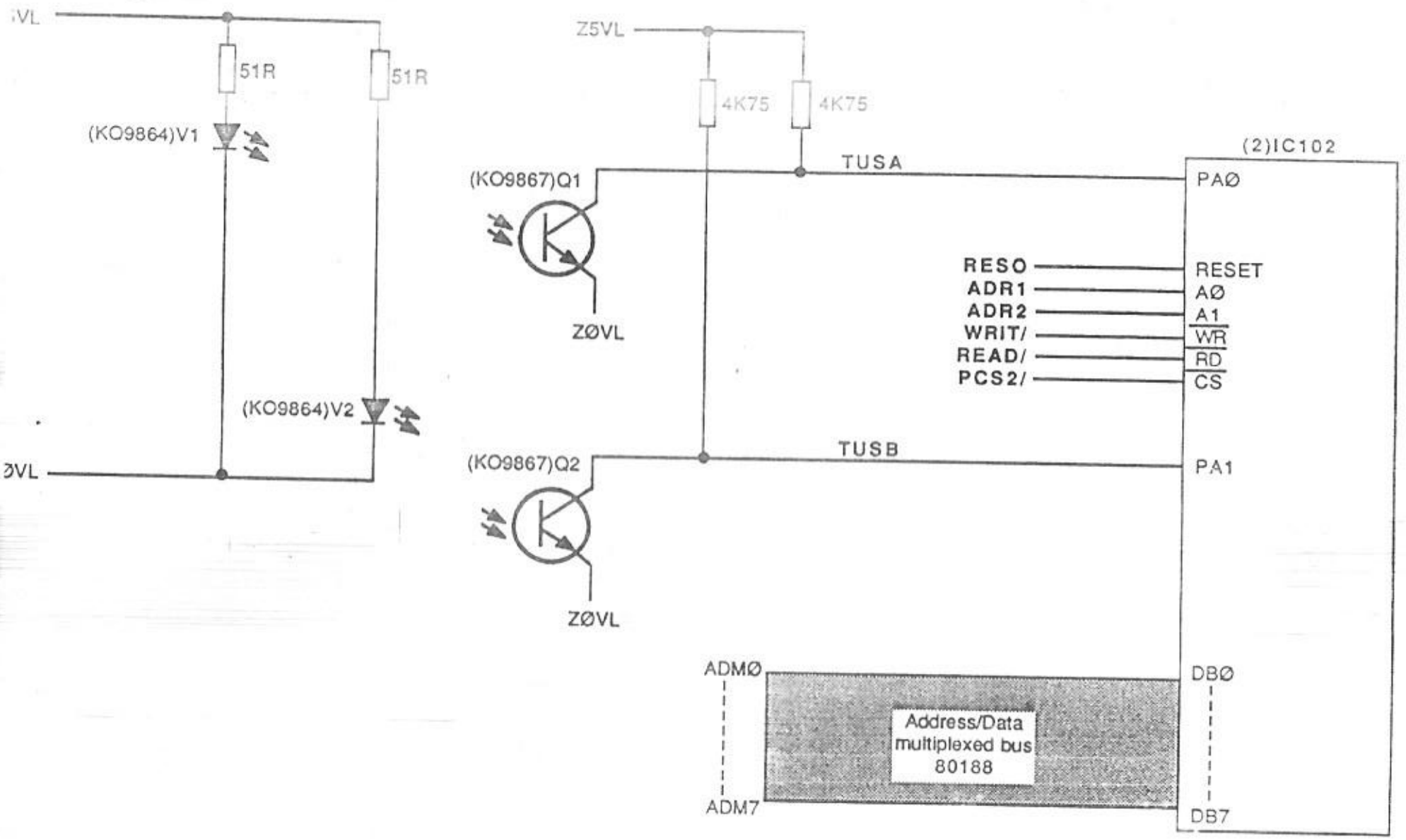
AK 100 Blood .eak Detektor

B.O. 02. 1988

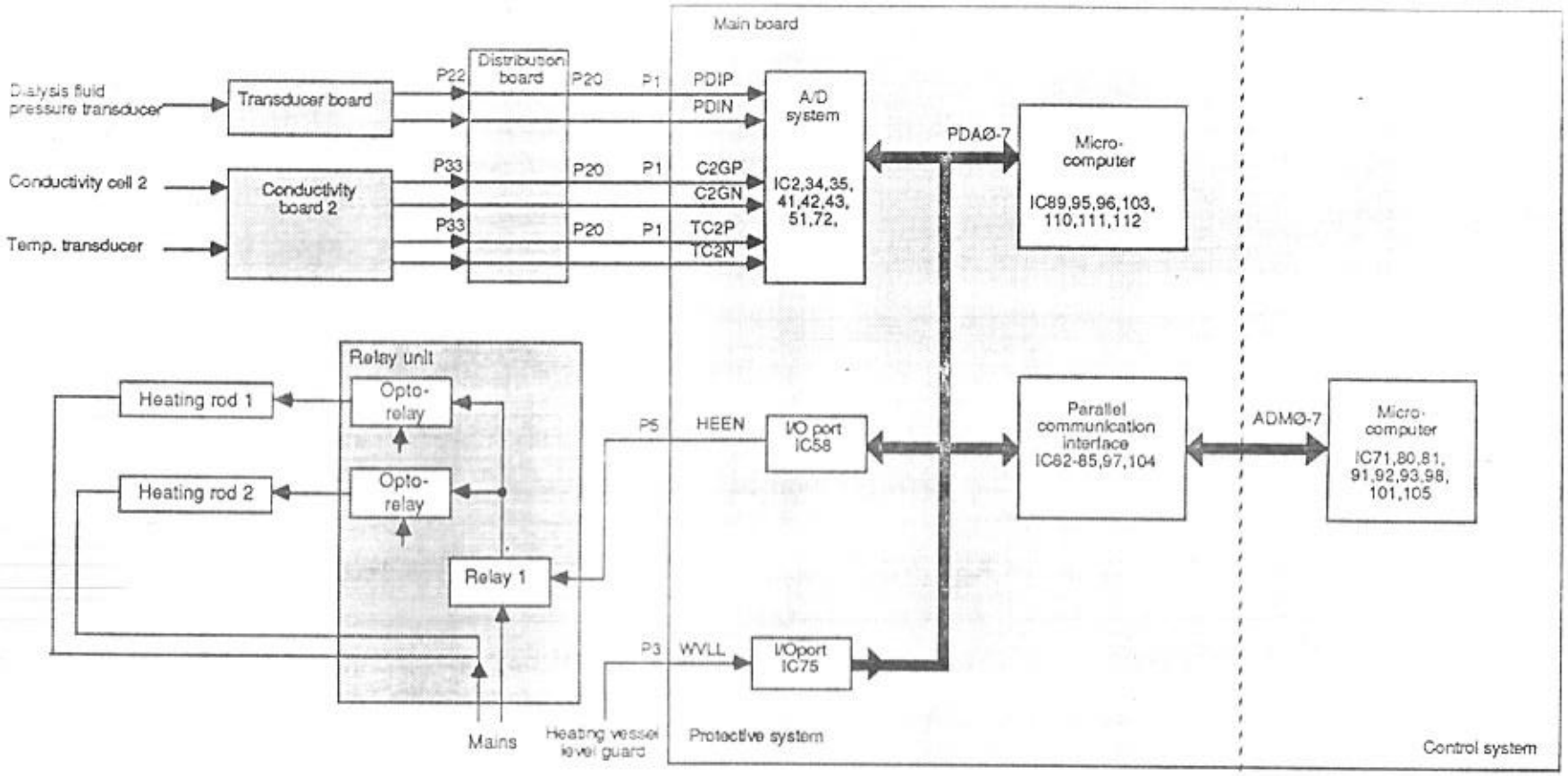


100 FM Tube sensors

03. 1988

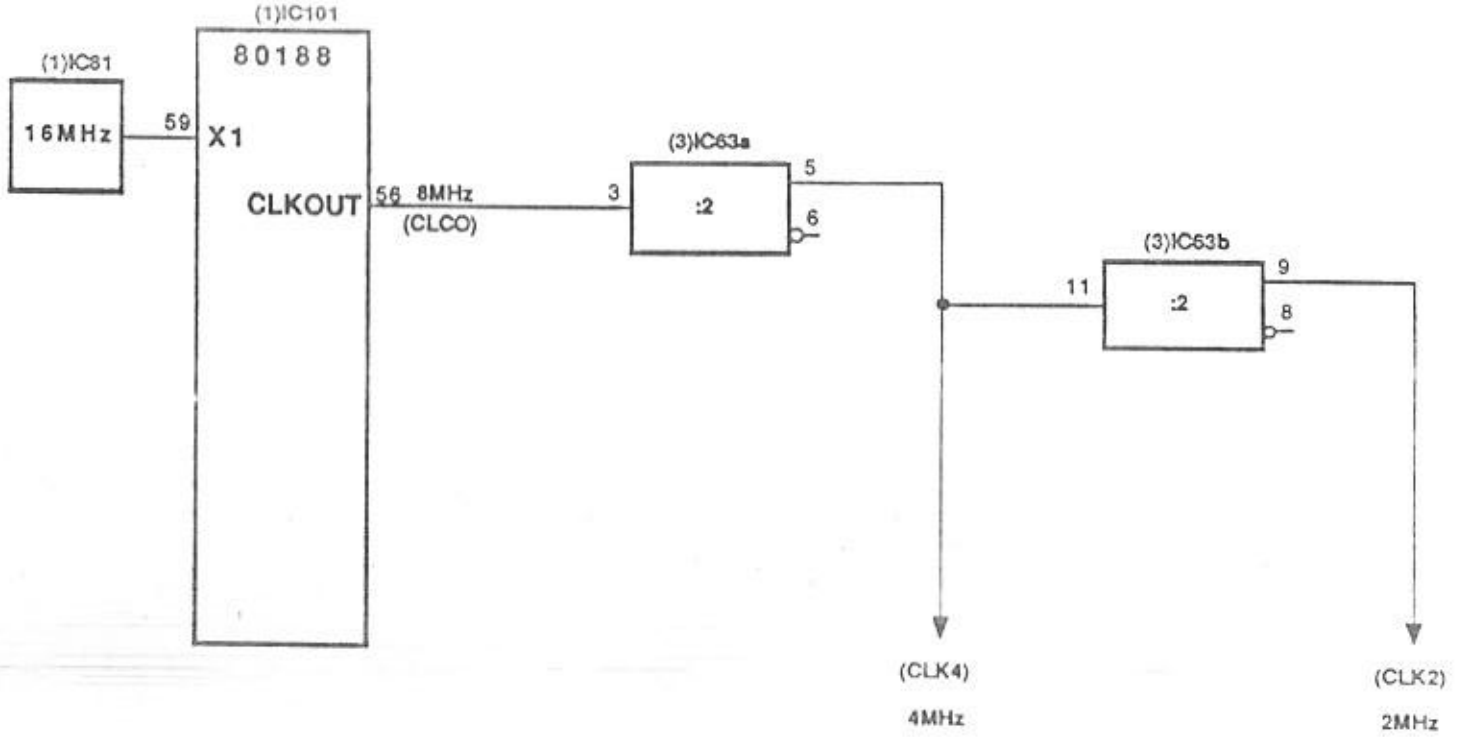


Dialysis fluid pressure, conductivity, and temperature measuring

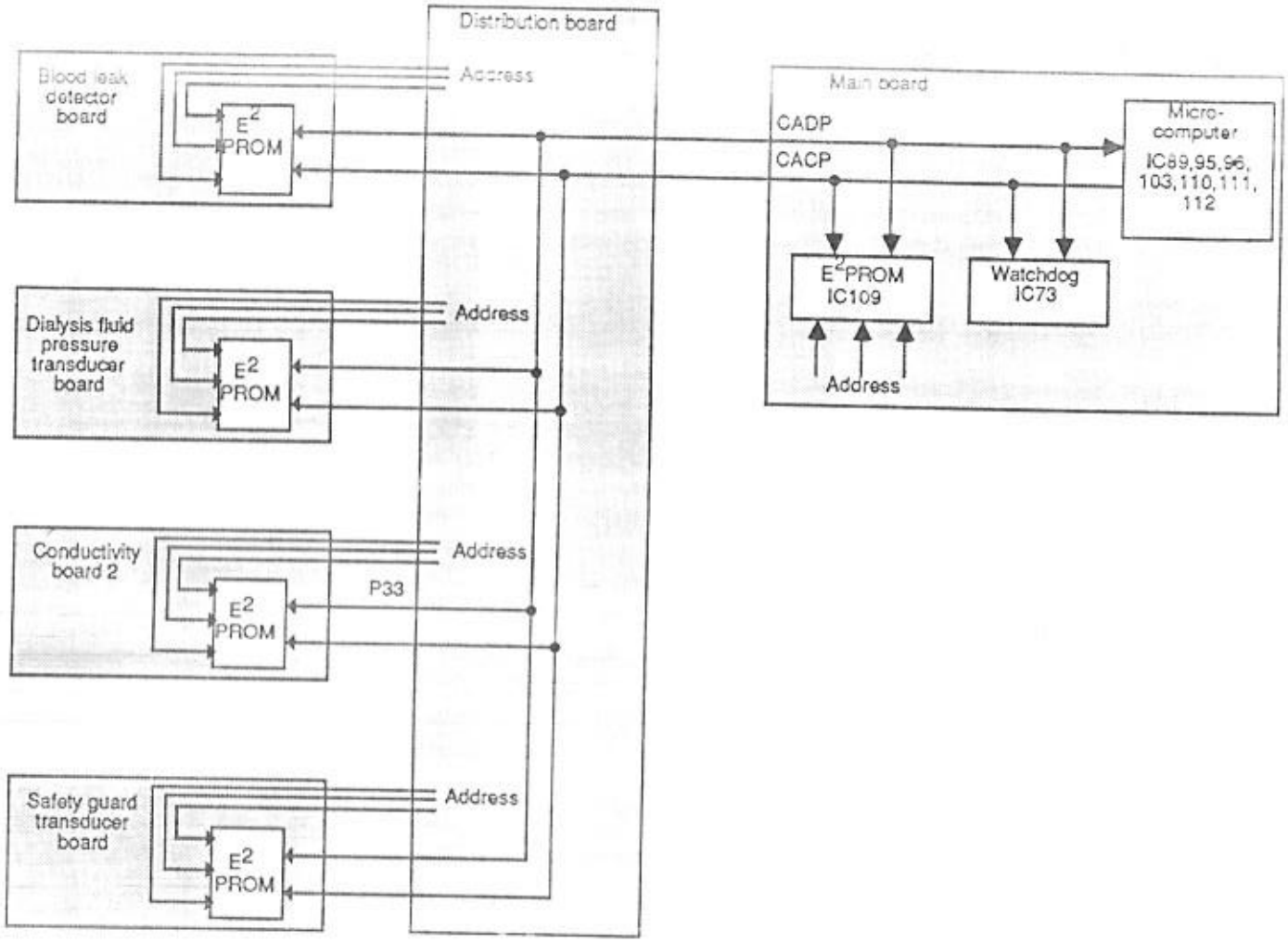


AK 100 FM Clockpulses

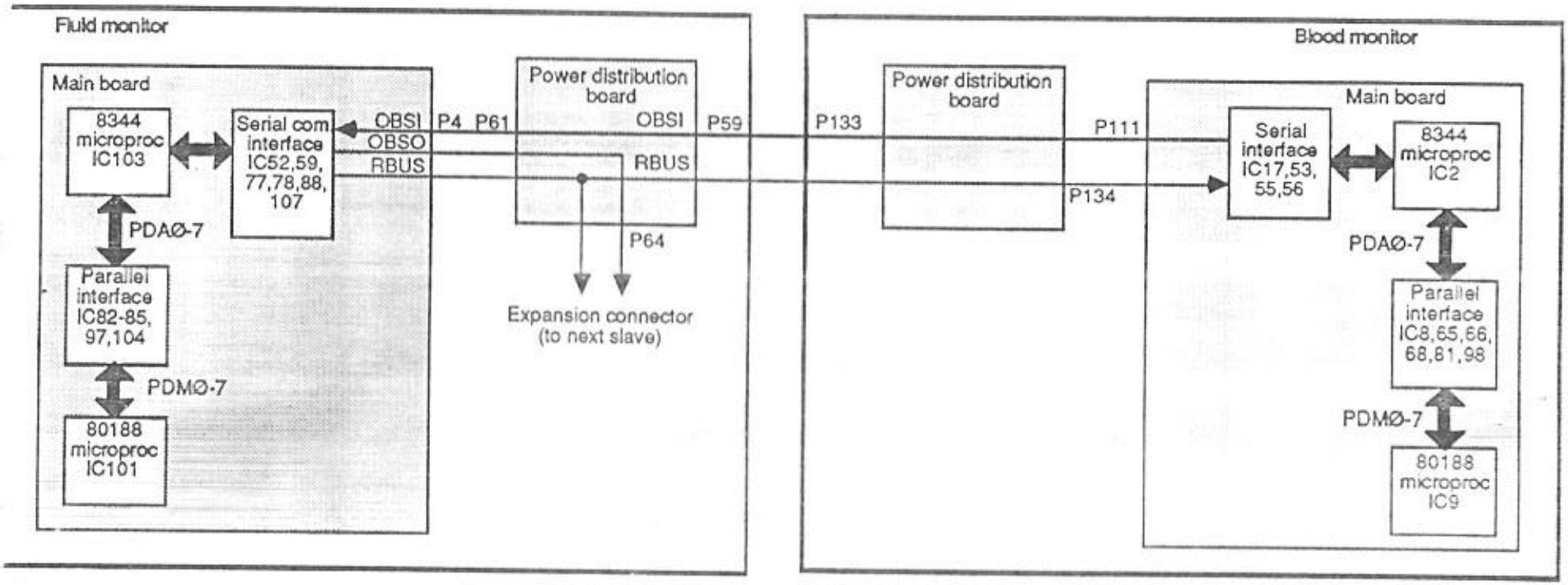
B.O. 06. 1988



E^2PROM control (Protective system)



erial and Parallel
ommunication Interface



E PROM control (Control system)